RECORDS

OF THE

AUSTRALIAN MUSEUM

EDITED BY THE DIRECTOR

Vol. XV.

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(53)

PRINTED BY ORDER OF THE TRUSTEES

CHARLES ANDERSON, M.A., D.Sc.,

DIRECTOR

SYDNEY. 1926-1927.

CORRIGENDA.

Page 168, line 16. For *australia* read *australis*.

Page 259, line 19. Delete *shearsbyi*

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Page 44, line 5 and footnote [c]. *For* Bogan *read* **Bogen.**

Page 95, fourth line from bottom. For ***walesius*** **read** ***rubriventris*****.**

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Published April 15th, 1926.

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Published November 18th, 1926.

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Published December 2nd, 1926.

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Published February 22nd, 1927.

No. 5.

Published April 6th, 1927.

No. 6.

Published 25th August, 1927.

LIST OF CONTRIBUTORS.

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ROBERT ETHERIDGE, JUNIOR

OBITUARY.

ROBERT ETHERIDGE, JUNIOR.

Palæontologist, 1887-1895; Curator, 1895-1917; Director and Curator, 1917-1920.

Robert Etheridge, Junior, was born in 1847. He was the only son of Robert Etheridge, Palæontologist to the Geological Survey of Great Britain, and, later, Assistant Keeper of the Geological Department of the British Museum, which no doubt explains why the study of fossils and Museum administration became his life work. The bibliography attached to this short notice is sufficient testimony, if any be necessary, to Etheridge's mental energy extending over fifty years of official life.

His scientific career commenced when he became a student of the Royal School of Mines, London, where, though he did not take his Associateship, he attended lectures by Tyndall, Huxley, Ramsay, and R. Etheridge, Senior.

While a student, he was a constant companion of his father, by whom he was initiated into the knowledge of the various modes of preservation of fossils, the treatment of the matrix, and the development of concealed structures. His Saturday afternoons were conscribed to assist his father, the washing, sorting, and labelling of the gatherings of the field staff being his share. All this gave him, at the most receptive time, the sense of touch and proportion, almost an instinct, which will reconstruct a shell from a fragment, and tell the horizon not only from the index fossil, but from the containing rock.

His training and application gained him his first official appointment as Assistant Geologist of the newly created Geological Survey of Victoria, regarded then as "one of the most complete Geological Surveys ever organized, except, perhaps, that of the United States Territories under Dr. F. V. Hayden." A. R. C. Selwyn was Director. The Survey was terminated in 1869, the officers being disbanded. Selwyn was appointed Director of the Geological and Natural History Survey of Canada in succession to Sir W. E. Logan. Etheridge, with his colleague Reginald A. F. Murray, afterwards Government Geologist of Victoria, spent some time in gold mining, returning to England in 1871. This was Etheridge's introduction to Australian geology, and led to his association with C. S. Wilkinson, who in 1874 became Geological Surveyor in New South Wales, and later induced him to come back to Australia. After his return to England, he was for some time engaged in coal mining in South Wales as underground manager in one of Crawshaw's Mines.

In 1873, he was appointed Palæontologist to the Geological Survey of Scotland. Then began the second stage of his scientific life. Entering into this position with little more than a student's knowledge of palæontology and stratigraphy, his indomitable energy brought him to the forefront of the younger school of English palæontologists. During this period he contributed to the Geological Magazine, the Geological

Society of Edinburgh, and the Annals and Magazine of Natural History, a number of short papers on new species, more particularly from the Carboniferous Limestone. His association with Henry Woodward commenced, and during 1873 a series of papers on the Dithyrocarids was published. In 1873 his paper " Observations on a few Graptolites from the Lower Silurian Rocks of Victoria ' (Annals and Magazine of Natural History) was published, and was one of the earliest articles on the rich graptolite fauna of Southern Victoria first recorded by McCoy in his " Exhibition Essay " of 1861, and later supplemented in his Decades of the Prodromus of the Palæontology of Victoria, and so greatly elaborated in the late T. S. Hall's numerous contributions to the Royal Society of Victoria and the Records of the Geological Survey of Victoria.

In 1874 he was appointed an Assistant in the Geology Department of the British Museum (Natural History) under Henry Woodward, his life-long friend, and with such associates as Smith Woodward, Bullen Newton, Richard Lydekker, and A. H. Foord. The volume of the work he published during this period can be gleaned from the Bibliography; at first he published much of the work resulting from his examination of the Palæozoic faunas of Scotland.

During 1874-5, Etheridge continued and greatly extended his observations on the fauna of the Carboniferous Limestone, more particularly in regard to the Lamellibranchiata, drawing attention to many points of structural importance.

In 1875-6, his attention turned again to points of Australian interest in his papers on Australian Tertiary Echinodermata (Quarterly Journal of the Geological Society, 1875), and on *Terebratulina*, *Waldheimia*, and *Terebratella*.

One of his ablest, though only a short paper, was on Austin's genus *Astrocrinites*, in which he discussed the genus proposed in 1842 in the light of specimens collected by James Bennie from the Scottish Carboniferous Limestone. This form was later dealt with in association with P. Herbert Carpenter in the British Museum " Catalogue of the Blastoidea." In 1876 he recorded his *Productus complectens*, a productid with spines clasping and fused to the stems of crinoids, later forming the type of Oehlert's genus *Etheridgina*.

His literary association with Robert Logan Jack, his colleague on the Geological Survey of Scotland, was initiated by a paper " On the Discovery of Plants in the Lower Old Red Sandstone . . . of Callandar." This association in authorship and friendship extended throughout two long official lives, and was from an Australian point of view firmly established by the publication of their " Catalogue of Works, Papers, etc., on the Geology, etc., of the Australian Continent ánd Tasmania," issued in 1881 and republished by the Department of Mines N.S. Wales in 1882 in the first edition of the " Mineral Products." This led up to their classical " Geology and Palæontology of Queensland and New Guinea," issued in 1892. The greater portion of Etheridge's share of this work was carried out at the British Museum before he left to take up his State appointment in 1887.

This work from an Australian point of view established an epoch in the recording of the geology of the State, which possessed vast mineral

resources and presented a problem of great geological interest, especially on the stratigraphical side. It had been preceded by short sketches and more or less summary accounts of the Geology of New South Wales by Clarke and Wilkinson, and of Queensland by R. L. Jack in his Exhibition Essay, but for the first time we had brought together a detailed account of the geology of a great province. The facts had been accumulated by many workers under arduous conditions, but the work of co-ordination fell into the hands of one man, Jack, whose preface bears evidence of the modesty of the author, who to account for suspected imperfections pleads that the record must be closed somewhere, and the same spirit inspired Etheridge, who entirely as a labour of love had for many years, both in England and Australia, devoted all his spare time to the elaboration of his friend's collections of fossils. His first work on the Queensland collections was published in 1880 by the Geological Society of Scotland, " On a collection of fossils from the Bowen River Coalfield and the . . . Fanning River Limestone," and this was supplemented by his lists of fossils contained in Jack's Essay on the Geology of Queensland, published for the Colonial and Indian Exhibition of 1886. When an Assistant at the British Museum he worked unofficially on the Queensland material, making comparisons with European allies. During this period, in addition to his strictly official work on national material, he collaborated with Alleyne Nicholson on a monograph of the Silurian fossils of Girvan, and with that author and A. H. Foord published papers on Queensland and European corals and monticuliporoids in the Proceedings of the Linnean Society of London and the Annals and Magazine of Natural History.

A glance at the bibliography will show the volume of descriptive and critical work he published during the period of his British Museum appointment.

In 1887 he took up his second Australian position as Palæontologist to the Geological Survey of N.S. Wales and the Australian Museum ; this step, which was of very little financial benefit to himself but of never-ending value to Australian geology, was brought about by the influence of his old colleague, C. S. Wilkinson, at that time in charge of the Geological Survey of N.S. Wales and a Trustee of the Australian Museum.

In 1891 I was a cadet on the Geological Survey and in 1892 was an assistant to him, and a considerable part of my time was devoted to preparing specimens for his examination. I was one of the very few, as Smith Woodward also remarked in his obituary notice in "Nature," who was allowed to see anything of his private life and to realise how he devoted his unoffiical time to his studies. At first, in Sydney, he, who had been in constant and ready touch with complete reference libraries and collections, had to wait for publications, copies of descriptions, tracings of illustrations and casts of types to be sent to him by his English colleagues. Many of his difficulties of comparison he used to discuss with me, and the way he helped me to discuss a point no matter how small leads me to realise, after years of experience, what a practical teacher he would have made.

On 1st January, 1895, Etheridge became Curator of the Australian Museum on the retirement of Dr. E. P. Ramsay, having previously served as Acting Curator during the illness of his predecessor. This may be

regarded as the commencement of the third and last stage in his scientific career. With characteristic energy and thoroughness he devoted himself during the remaining years of his life to the duties of this position. The collections under his charge expanded and improved enormously during his tenure of the curatorship, and scientific investigation was vigorously prosecuted under his direction. While not abating his palæontological researches he gradually devoted more and more attention to ethnology, and the large collection of ethnological objects of Australian and Pacific origin, which now form one of the most striking features of the Museum, owes much to his keen and far-sighted interest. When the new south wing was completed in 1909 Etheridge planned and supervised the arrangement of the exhibits with the greatest enthusiasm, and expressed the hope that these galleries would be his monument.

Among the more important of his palæontological writings during this period are the lengthy descriptions of the corals of the Tamworth district (Records of the Geological Survey of N.S. Wales, xi, 3,1899, p. 151), a monograph on the Cretaceous mollusca of South Australia and the Northern Territory (Memoirs of the Royal Society of South Australia, ii, 1 , 1902, p. 54) two contributions on the Cretaceous fossils of Natal (2nd and 3rd Reports of the Geological Survey of Natal, 1904 and 1907), and a description of Carboniferous fossils from the Irwin River, Western Australia (Bulletin of the Geological Survey of W. Australia, No. 2, 1907).

During the same period he made numerous and important contributions to ethnological literature, a full list of which will be found in the appended bibliography, but special mention may be made of his elaborate works on the cylindro-conical and cornute stone implements (Memoirs of the Geological Survey of New South Wales, Ethnology, No. 2, 1916) and on the dendroglyphs or "carved trees" of New South Wales (Memoir of the Geological Survey of New South Wales, Ethnology, No. 3, 1918). He wrote two papers dealing with the geological history of man in Australia, one a short note entitled "Antiquity of Man in Australia" (Records of the Australian Museum, xi, 2, 1916) and "The Warrigal or Dingo, introduced or indigenous ?" (Memoir of the Geological Survey of New South Wales, Ethnology, No. 2, 1916). Historical research had a great attraction for him, and he published two papers on the early history of the Australian Museum (Records of the Australian Museum, xi, 4, 1916, and xii, 12, 1919).

Etheridge was a great curator, a thorough and painstaking scientific worker and devoted himself wholeheartedly to whatever he took in hand, being meticulously careful to make his work exact and his observations clear. Somewhat conservative by nature, he had no sympathy with speculation, and directed his attention chiefly to the accumulation of facts. His industry was remarkable, and he seldom allowed himself any respite from his labours. In his later years his health was by no means good, but his iron will drove his unwilling body to its accustomed tasks to the very end, and his fine intellect was unimpaired when he was stricken by his last illness.

He had no hobbies and took but little part in scientific meetings, though he was a fluent and forceful speaker when he chose. He was rather self-centred and had few intimate associates, but to those who were

fortunate enough to gain his liking he showed himself a staunch friend. He was a man of strong prejudices, to many he appeared rather austere and his somewhat sardonic humour did not commend itself to everyone who came into contact with him. He was not able to suffer fools gladly, but beneath the crust he had a warm and generous heart. He had no liking for publicity or ostentation of any kind, which no doubt accounts for the fact that the scientific honours he received were not commensurate with his great ability and tremendous output of valuable work. In 1877 the Geological Society of London awarded him the Wollaston Fund, and he received the Clarke Memorial Medal of the Royal Society of New South Wales in 1895, and the Mueller Medal of the Australian Association for the Advancement of Science in 1911.

W. S. DUN.

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(Compiled by W. A. RAINBOW.)

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8. Report on a sample of Clay from above a Coal-Seam on the Coast, at least six miles south of Pelican Flat, Lake Macquarie, New South Wales.
9. Report on a sample of Tertiary Clay from Kiandra, New South Wales.
10. Report on Fossils forwarded by the Rev. J. Milne Curran, from a new locality in the Cobar District, New South Wales.
11. Further Preliminary Examinations of *Diatomite* (Diatomaceous Earth) from New South Wales localities.
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IN THE PRESS.

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STUDIES IN AUSTRALIAN FISHES.

No. 8.*

By

(The late) Allan R. McCulloch, Zoologist, Australian Museum.

(Plate i.)

Family Syngnathidae.

Hippocampus *Rafinesque*.

Hippocampus Rafinesque, Caratteri Alc. Gen. Spec. Silicia, Apr. 1810, p. 18 (type *heptagonus* Rafinesque)—*vide* Jordan, Gen. Fish., i, 1917, p. 79.

Hippocampus Perry, Arcana, May 1810, pl. xviii (*foliatus*)—*vide* Mathews & Iredale, Vict. Nat., xxix, 1, 1912, p. 15.

Authorship and Genotype.—In their paper on Perry's "Arcana" quoted above, Mathews & Iredale gave "a resume of its contents," and drew attention to a number of generic and specific names which had been generally overlooked by later writers. They drew attention to the genus *Hippocampus* which they erroneously believed to have been first published by Perry, with *H. foliatus* as its type. According to Jordan (*supra*), however, the name was used by Rafinesque in his "Caratteri" which was published on 1st April, and therefore preceded Perry's work by one month. Credit of the name *Hippocampus* accordingly remains with Rafinesque, and his species *heptagonus* is its genotype.

Mr. T. Iredale has been good enough to secure for me, through his friend Mr. F. C. Griffin of the British Museum, a typed copy of Perry's notes upon *Hippocampus* in the letterpress relating to plate xviii. These are more curious than useful, and lead one to conclude that this author of last century classified animals by way of external appearances rather than the slower and more tedious study of comparative anatomy. He suggested that *Hippocampus* could scarcely be regarded as a true fish, but might "with more exactitude" be "not improperly" described "as a marine insect." Its head and neck were likened to those parts of a horse, and its tail was compared with the nether end of a mermaid, resemblances which perhaps induced consideration by this erudite naturalist of possible affinities with the mammalia.

Family Pegasidae.

Parapegasus natans *Linnaeus*.

Parapegasus natans (Linnaeus) McCulloch, Biol. Res. "Endeavour," iii. 3, 1915, p. 110, fig. 2.

*For No. 7, see "Records," xiii, No. 4, 1921, p. 123.

Locality.—Young Island, Queensland; collected by Dr. W. E. J. Paradice, R.A.N.

A tropical species extending southward to the Swan River in the west, and to Lake Macquarie, New South Wales in the east.

Specimens are in the Australian Museum from Swan River, Western Australia; Gulf of Carpentaria, N. Australia; Bowen, off Double Island Point, Moreton Bay, Queensland; Tuggerah Lakes, New South Wales; Malay Archipelago.

Length to 126 mm.

Family ATHERINIDAE.

RHADINOCENTRUS ORNATUS *Regan*.

Rhadinocentrus ornatus Regan, Trans. Zool. Soc. London, xx, 6, 1914, p. 280, pl. xxxi, fig. 1. *Id*., Cockerell, Mem. Qld. Mus., iii, 1915, p. 38—scales only. *Id*., Ogilby, Mem. Qld. Mus., vi, 1918, p. 99—record only. *Id*., Jordan & Hubbs, Stanford Univ. Series, Monogr. Atherinidae, 1919, p. 27. *Id*., Messmer, Qld. Nat., iv, 5, 1924, p. 95.

Four specimens of this very interesting fish, 31-39 mm. long, have been presented to the Australian Museum by Mr. H. E. Finckh. They were collected at Boambie Creek, five miles south of Coff's Harbour, New South Wales, and are the first representatives of the species to be made known from the mainland. Those described by Regan were only 25-37 mm. long, and were captured in a pond on Moreton Island, south Queensland. Others have been collected recently from small streams on the same island by Mrs. C. A. Messmer who describes their life-colours in a paper quoted above.

Family BREGMACEROTIDAE.

BREGMACEROS MACCLELLANDI *Thompson*.

Bregmaceros macclellandi (Thompson) Gunther, Challenger Rept., Zool., xxxi, 1889, pp. 22, 25, pl. iii, figs. a-b. *Id*., Kent, Proc. Roy. Soc. Qld., vi, 1889, p. 240.

In the year 1888, Captain Foley Vereker of H.M.S. "Myrmedon" invited Mr. Saville Kent, Commissioner of Fisheries for Queensland, to accompany him to the Cambridge Gulf, north-western Australia on a surveying cruise. The collections made were examined and recorded by Messrs. C. W. De Vis, C. Hedley, and W. Saville Kent, and in a mere list compiled by the last named author. *B. macclellandi* is recorded from the Cambridge Gulf. The inclusion of this interesting species in the Australian faunal list has remained dependent upon this single unsatisfactory record, the fish having been recognised by no later writer from our waters. It is therefore of special interest to record a second example collected by Dr. W. E. J. Paradice, R.A.N., during a surveying cruise of H.M.A.S. "Geranium."

The single specimen is unfortunately very young, being only 33 mm. long, but the following characters can be made out. D.i/50; the 15th to 30th rays are short but apparently united with the others by membrane. A.53; the 20th to 30th short like those of the dorsal. 5 ventral rays; the two anterior short and branched, the three others simple and very elongate. About 73 scales between the shoulder and the base of the tail. Depth of body 4.5 mm.; length of head 5.5 mm., and diameter of eye 1.5 mm. The eye is largely covered by a transparent membrane. Colour white in formalin, with a narrow grey band which extends backward from the occiput to the base of the tail near the back; fins colourless.

This specimen resembles *B. japonicus* as figured by Tanaka,[1] but the vaiiations recorded in Gunther's excellent study of the species in the Challenger report quoted above, suggest that the Japanese species is not distinct from *B. macclellandi*.

Locality.—Darwin, Northern Territory; coll. Dr. W. E. J. Paradice, R.A.N.

Family SERRANIDAE.

CENTROGENYS WAIGIENSIS *Quoy & Gaimard.*

Centrogenys waigiensis (Quoy & Gaimard) Bleeker, Atlas Ichth., vii, 1875, p. 68, pl. 297, fig. 1.

Locality.—Darwin, Northern Territory; collected by Dr. Paradice. This species has been recorded from various localities on northern coasts, between Freycinet Harbour, Western Australia and Port Molle, Queensland.

Specimens are in the Australian Museum from Shark Bay; Mapoon (Hedley); Port Curtis (McCulloch); Port Denison (Rainford); and Moreton Bay (Ogilby). Length 124 mm.

Family RACHYCENTRIDAE.

RACHYCENTRON PONDICERIANUM *Cuvier & Valenciennes.*

Elacate nigra (Bloch) Gunther, Brit. Mus. Cat. Fish., iii, 1860, p. 375—part. *Id.*, Day, Fish. India, pt. 2, 1876, p. 256, pl. lv, fig. 2.

Elacate pondiceriana Ruppell, Neue Wirbelth., Fische, 1835, p. 43, pl. xii, fig. 3.

Variation with growth.—A large specimen, 975 mm. long to the end of the middle caudal rays, only differs from smaller examples in the form of its fins, which, because of the prolongation of some anterior or exterior rays, alter in shape with growth. The anterior dorsal and anal rays form a pointed lobe on each fin which is not developed in the young; the pectorals of large specimens are more falcate and the caudal more deeply

[1] Tanaka—Fishes of Japan, xi, 1913, p. 190, pl. li, fig. 197.

forked than in smaller ones. These differences are indicated in the figures published by Day of the young and by Ruppell of the adult. The light and dark bands extending along each side of the body, which are so characteristic of younger examples of this species, are scarcely discernible in the large one under discussion, but the sharply defined light area on the abdominal surface is very distinct.

Localities.—The species is not rare, but being largely an inhabitant of the open seas, is not often captured. Specimens are in the Australian Museum from various localities on the coast of New South Wales; Fremantle, Western Australia; and Madras, India—Dr. F. Day's collection. The large example collected by Dr. Paradice was caught between 17° and 19° S. lat., Great Barrier Reef, Queensland.

R. pondicerianum has been recorded from Queensland, New South Wales, and Western Australia.

Family CARANGIDAE.

CARANX GYMNOSTETHOIDES *Bleeker.*

Carangoides gymnostethoides Bleeker, Nat. Tijdschr. Ned. Ind., i, 1851, p. 364.

Caranx gymnostethoides Gunther, Brit. Mus. Cat. Fish., ii, 1860, p. 431. *Id.*, Day, Fish. India, pt. 2, 1876, p. 217, pl. xlviii, fig. 6.

An example, 455 mm. long from the snout to the end of the middle caudal rays, agrees with Day's description and figure in all but a few unimportant details. The head is tilted a little upward in his figure, which makes the abdominal curve appear greater instead of less than that of the back. In my specimen, the head, including the opercular membrane is 3.3 in the length to the end of the middle caudal rays; depth at the origin of the second dorsal fin 3.6 in the same. D.viii, i/32; A.ii/26.

Locality.—Great Barrier Reef, Queensland, between 17° and 19° S. lat.; Dr. W. E. J. Paradice, R.A.N. coll.

CARANX OBLONGUS *Cuvier & Valenciennes.*

Caranx oblongus Cuvier and Valenciennes, Hist. Nat. Poissons, ix, 1833, p. 128. *Id.*, Day, Fish. India, pt. 2, 1876, p. 222, pl. li, fig. 1. *Id.*, Ogilby, Mem. Qld. Mus., iii, 1915, p. 134.

Caranx auriga De Vis, Proc. Linn. Soc. N.S. Wales, ix, 1884, p. 539.

Citula gracilis Ogilby, Mem. Qld. Mus., iii, 1915, p. 75, pl. xxiii.

D.viii, i/22; A.ii, i/18; P.i/19; V.i/5; C.17. About 38 scutes on the lateral line.

Length to the end of the middle caudal rays 236 mm. Depth at the origin of the second dorsal (82 mm.) 2.6 in the length to the hypural joint (216); head (60) 3.6 in the same. Eye (15) 1.2 in the snout (18); interorbital space (13) 4.6 in the head. Pectoral fin (93) 0.5 longer than the head. Third dorsal spine (27) 8.0, filamentous dorsal ray (126) 1.7, longest gill-raker (7) 30.8 in the length to the hypural joint.

Body much compressed; the upper profile from the snout to the caudal peduncle forms a convex arch, the lower is almost an oblique line from the chin to the origin of the anal fin. Hinder angle of the maxillary reaching beyond the vertical of the anterior border of the eye when the mouth is closed; it is obliquely truncate posteriorly with a large supplemental bone above it. Adipose eyelid forming a narrow rim around the eye which is broadest above the antero-superior angle. Preopercular edge minutely crenulate, its hinder margin subvertical, and the angle broadly rounded. Cheek, upper portion of the operculum, and the temporal region with small scales; the remainder of the head and a median area reaching backward to the first dorsal spine naked.

Each premaxillary with a band of small teeth which is broadest anteriorly and becomes narrower posteriorly, a few of the outer teeth are fixed, conical, and larger than the others, among which they are irregularly scattered, but there are no canines. Mandible with a band of small teeth on each side, of which a few outer are rather larger than the others anteriorly. A triangular patch of small teeth on the vomer, a band on each palatine, and others on the tongue. Nineteen gill-rakers on the lower limb of the first gill-arch, they are tuberculiform and spinose anteriorly, but increase in length backward, one at the angle being about half as long as the eye.

The body is almost entirely covered with small scales, but the breast is naked backward to the ventral fin; this naked area is sharply defined above by a patch of scales which extends forward below the base of the pectoral fin to the margin of the gill-opening. The bases of the pectoral fins are naked; the dorsal and anal fins have scaly sheaths covering the bases of the anterior rays. Lateral line arched anteriorly, becoming straight below the eighth dorsal ray; the straight portion is slightly longer than the curved portion. The whole of the straight portion of the lateral line is armed with scutes, which are broadest between the posterior dorsal and anal rays.

Dorsal spines slender, the third longest and a little longer than the post-orbital portion of the head; the eighth spine is isolated between the two dorsal fins and, with the others preceding it, lies in a groove. Seven anterior dorsal rays forming a falciform lobe; the second ray is longest and produced into a filament which reaches backward to a little beyond the middle of the upper caudal lobe. Anal spines small; six anterior anal rays forming a falciform lobe, the first ray is considerably longer than the others. Pectoral falcate, reaching beyond the angle of the lateral line. Ventral fin inserted behind the base of the pectoral, and a little in advance of the vertical of the origin of the first dorsal; the spine is slender and much shorter than the first ray. Caudal broadly forked.

Colouration.—Silvery below, light brownish-grey above; short dark oblique streaks, becoming broader posteriorly, along the top of the sides, they correspond to the spaces between the dorsal rays and fade out on the sheath of the dorsal fin; a row of similar, but very faint, streaks immediately above the anal, each streak corresponding to a ray. Anal, ventral, and pectoral fins white; dorsal fins whitish suffused with smoky-grey, the

edges of the rays dark-tipped, an irregular black blotch at the ends of the third to sixth dorsal rays. Caudal smoky-grey, the ends of the rays darker on the upper lobe than those of the lower. Inner axil of pectoral dusky.

Described from a specimen, 236 mm. long to the end of the middle caudal rays.

Synonymy.—While working at various Carangids in the collection of the Queensland Museum, Ogilby examined the holotype of *Caranx auriga* De Vis and identified it as *C. oblongus* Cuvier & Valenciennes. At the same time, he described and figured a fish from Darnley Island, for which he proposed the new name *gracilis*. This is of rather more slender form than is usual in *C. oblongus*, but is so similar to that species in all other details that I believe it to be referable to the same species.

Localities.—The type of *auriga* was collected at Cairns, Queensland, and that of *gracilis* at Darnley Island, Torres Strait. A fine specimen, 246 mm. long, from the snout to the end of the middle caudal rays, was collected for the Australian Museum at Great Palm Island, near Cairns, by Dr. W. E. J. Paradice, of H.M.A.S. " Geranium."

CARANX STELLATUS *Eydoux & Souleyet.*

Caranx stellatus Eydoux & Souleyet, Voy. Bonite, Poiss., 1841, p. 167, pl. iii., fig. 2. *Id.*, Jordan & Jordan, Mem. Carneg. Mus., x, 1, 1922, p. 40.

Caranx melampygus Gunther, Brit. Mus. Cat. Fish., ii, 1860, p. 446, and Fische Südsee, v, 1876, p 133, pl. lxxxvi. *Id.*, Day, Fish. India, 1876, p. 214, pl. 1, fig. 3. *Id.*, Jordan & Evermann, Bull. U.S. Nat. Mus., xxiii, 1, 1903, p. 192, fig. 73. *Id.*, McCulloch, Mem. Qld. Mus., viii, 1, 1924, p. 70, pl. xi, fig. 2.

Record.—Two young examples, 174-203 mm. long to the end of the middle caudal rays, were secured on the Great Barrier Reef, near Townsville, Queensland, by Dr. W. E. J. Paradice, R.A.N., during a surveying cruise of H.M.A.S. " Geranium." The species has not been recognised hitherto from Australian waters.

Nomenclature.—This species has been generally identified as *C. melampygus* but, according to Jordan and Jordan, the fish which Cuvier and Valenciennes first described under that name is another species. If that supposition be correct, the specimen here recorded from Queensland must be referred to *C. stellatus* Eydoux and Souleyet.

C. stellatus is near *C. forsteri*, but differs in having a smaller eye ; it is shorter than the snout in specimens about nine inches long instead of longer than in *forsteri*. The maxillary bone only just reaches the vertical of the middle of the eye in *stellatus* and its breadth is less than half the length of the snout, whereas in *forsteri*, it reaches backward to below the posterior half of the eye and its width is equal to about two-thirds the length of the snout. The interorbital width is much greater and the snout much more obtuse in *forsteri* than in *stellatus*.

NAUCRATES DUCTOR *Linnaeus.*

(Plate i.)

Gasterosteus ductor Linnaeus, Syst. Nat., 10th ed., 1758, p. 295.

Xystophorus Richardson, Ichth. " Erebus " & " Terror," 1844, p. 52, pl. xxx, fig. 2.

Naucrates ductor Lutken, " Spolia Atlantica," 1880, p. 504, pl. iii, figs. 14-15.

Seriola quinqueradiata Lutken, *Ibid.* p. 528, pl. iv, figs. 8-9.

Four young specimens, 22.5 - 42 mm. long, exhibit remarkable variation and show that the keel on each side of the caudal peduncle which has been regarded as a generic character is not developed in the young. The smallest specimen is a little more advanced than that figured by Lutken (Spolia Atlantica, pl. iii, fig. 15). The larger examples are very similar to his fig. 8, pl. iv which he identifies as *Seriola quinqueradiata*, and indicate that his specimen was really the young of *Naucrates.*

Description of youngest specimen.—D.iv, 29 ; A.ii, 18 ; V.i, 5 ; P.19 ; C.17. Depth before ventrals (7 mm.) 2.5 in length to base of middle caudal rays (18) ; head (7) also 2.5 in the same, its length being equal to the height of the body. Eye very large (3) 2.3 in the head. Height of the longest of the anterior dorsal rays a trifle greater than the length of the eye ; first ventral ray (5) 1.4 in the head.

Head brown above, silvery on the sides. Greater part of the body brown, with broad and well-defined silver bands, which are very striking anteriorly but become less conspicuous towards the tail ; they do not extend across the dorsal and ventral surfaces as in later stages, but are separated by the brown ground-colour. Black areas are present on the dorsal and anal fins arranged as shown in the figure. A large black patch on each ventral fin, and narrow dark lines extend along single rays in the upper and lower halves of the caudal fin.

Two or three prominent teeth project obliquely forward from the premaxilliaries near their symphysis, which is notched on the median line ; microscopic teeth form a row on each side of the lower jaw. A bony crest immediately above the supraorbital rim bears two flat spines, and a moveable bone above the shoulder has a basal spine directed obliquely upward and another pointing backward. Preopercular angle produced into a large spine ; there is a smaller one above it on the hinder margin, and two in advance of it on the lower margin ; an inner crest bears two small spines near the angle. A large, smooth, and concentrically striated bony boss is present on each side of the upper surface of the head near the occiput. Lateral line consisting of a row of simple pores, arched anteriorly, thence descending obliquely to the middle of the sides. Caudal peduncle strongly compressed, without trace of any lateral keel.

This differs from the two younger stages figured by Lutken[2] from

[2]Lutken—Spolia Atlantica, 1880, pl. iii, figs. 14-15.

specimens 9 and 14 mm. long, only in the reduction of its cephalic spines and development of its colour-marking.

Described and figured (Plate i, fig. 1) from the youngest specimen, 22.5 mm. long, from Shell Harbour, New South Wales.

Localities.—Maroubra Bay, near Sydney; found stranded on the beach by Mr. Thomas Whitelegge (Plate i, fig. 2).

Shell Harbour, New South Wales; collected by Mr. G. McAndrew (Plate i, fig. 1).

Family CHAETODONTIDAE.

CHAETODON SETIFER *Bloch.*

Chaetodon setifer (Bloch) McCulloch, Rec. Austr. Mus., xiv, 1, 1923, p. 3 (references).

Variation.—A series of eighteen specimens, 57-172 mm. long, shows but little variation in colour-marking, only the dark-edged band on the caudal fin changing its position with growth. In the smaller specimens, it is within the anterior half of the fin, but moves backward as the fish increases in size towards the posterior margin, and remains there even in the largest specimens. The rounded black spot on the dorsal fin, characteristic of *C. setifer*, is fully developed in all my specimens. The filamentous prolongation of the fifth or sixth dorsal ray first appears in specimens about 95 mm. long.

Synonymy.—The relationship of this species and *C. auriga* Forskal has been much discussed, some authors considering it a mere colour-variation of the latter, while others regard the two as distinct species. In a recent paper on some fishes of the Red Sea, Miss R. C. Bamber[3] recorded "seven specimens, forming a complete series from *C. setifer*, Bloch, with a distinct black spot on soft dorsal, to *C. auriga* Forskal, with no trace of a spot." On the other hand, Jordan and Seale,[4] maintained that the dorsal ocellus of *setifer*, and other characters, separated that species from *auriga*. My series supports the latter authors' contention. It is possible that the *auriga* form is merely a geographical subspecies restricted to the Red Sea and Indian Ocean.

Localities.—Peart Reef, off Innisfail, Queensland; "Geranium" coll. Holbourne Island, off Port Denison; coll. E. H. Rainford. Iluka, Clarence River estuary, New South Wales; coll. State Fisheries Dept. Specimens are in the Australian Museum from the New Hebrides, Solomon Islands, Samoa, Friendly Islands, Funafuti, and Papua.

C. setifer has been recorded from Sydney by Kner,[5] Port Jackson by Steindachner,[6] and as *nesogallicus* from Botany Bay by Gunther[7]; Castelnau[8] recognised it from Cape York.

[3]Bamber—Journ. Linn. Soc., Zool., xxxi, 1915, p. 481.
[4]Jordan and Seale—Bull U.S. Fish. Bureau, xxv, 1906, p. 338.
[5]Kner—Voy. Novara Fische, 1865, p. 98.
[6]Steindachner—Sitzb. Akad. Wiss. Wien., liii, 1866, p. 435.
[7]Gunther—Voy. Challenger, i, 6, 1880, p. 27.
[8]Castlenau—Res. Fish. Austr., 1875, p. 13.

GONOCHAETODON TRIANGULUM *Cuvier & Valenciennes.*

Tetragonoptrus (*Gonochaetodon*) *triangulum* (Cuv. & Val.) Bleeker, Atlas Ichth., ix. 1878, p. 53, pl. ccclxxiv, fig. 1.

Locality.—Three specimens, 105-125 mm. long, were collected by Dr. Paradice on Peart Reef, off Innisfail, Queensland. They are the only representatives of this monotypic genus so far made known from Australian waters. Numerous specimens are in the museum collection from Papua, New Hebrides, Solomon Islands, and New Britain.

Family AMMODYTIDAE.

BLEEKERIA VAGA *McCulloch & Waite.*

Bleekeria vaga McCulloch & Waite, Trans. Roy. Soc. S. Austr., xl, 1916, p. 447, pl. xliii, fig. 1.

A young example, 65 mm. long, is probably referable to this species. It is unfortunately somewhat shrivelled and the rays of the dorsal and anal fins cannot be satisfactorily counted. Comparison with the typical specimen, which is from Lord Howe Island, leads to the belief that the two specimens represent the same species, though the latter is robust and subcylindrical, while the young specimen, being shrunken, is compressed.

Locality.—Shell Harbour, New South Wales.

No species of the family Ammodytidae has been previously recognised from Australia.

Family SCORPAENIDAE.

SCORPAENA CRUENTA *Richardson.*

Scorpaena cruenta Richardson, Ann. Mag. Nat. Hist., ix, 1842, p. 217. *Id.*, McCulloch, Rec. W. Austr. Mus., i, 2, 1912, p. 94.

Scorpaena militaris Richardson, Ichth. "Erebus" & "Terror," 1845, p. 22, pl. xiv, figs. 1-2.

I have stated in the paper quoted above (1912) that this species is not common in New South Wales waters. Several small specimens, 46-58 mm. long, were collected by Mr. G. McAndrew at Shell Harbour, where the species is common in rock-pools. Another was collected by Mr. Charles Hedley at Narooma, New South Wales. A fine series of eighteen specimens, the largest of which is 155 mm. long, was collected by Mr. Hedley at various localities on the eastern coast of Tasmania.

SCORPAENA BYNOENSIS *Richardson.*

Scorpaena bynoensis Richardson, Ichth. "Erebus" & "Terror," 1845, p. 22, pl. xiv, figs. 3-4.

Sebastapistes laotale Jordan & Seale, Bull. U.S. Fish. Bur., xxv, 1906, p. 376, fig. 72.

Locality.—Cape Wessell, Arnheim Land; collected by Dr. Paradice.

A common species in North and West Australia. Numerous specimens are in the Australian Museum from Port Darwin, Gulf of Carpentaria, Murray Island, St. Crispin Reef, Dunk Island, New Hebrides, and Samoa.

Family CONGIOPODIDAE.

CONGIOPODUS *Perry*.

Congiopodus Perry, Arcana, 1810, pl. lv and letter-press (*C. percatus* Perry), *vide* Marschall, Nomencl. Zool., 1873, p. 71, and Mathews & Iredale, Vict. Naturalist, xxix, 1, 1912, p. 15.

Congiopodus (Perry) *vel Agriopus* (Cuvier) Gunther, Proc. Zool. Soc., 1871, p. 659.

Congiopodus Gill, Mem. Acad. Sci. Wash., vi, 1893, p. 118—name only.

Les Agriopes Cuvier, Regne Anim. (2), ii, 1829, p. 168 (*Blennius torvus* Walbaum).

Agriopus Gunther, Brit. Mus. Cat. Fish., ii, 1860, p. 137.

Cephalinus (Gronow) Gray, Cat. Gronow's Fish. Brit. Mus., 1854, p. 159 (*Blennius torvus*).

Congiopus Regan, Ann. Mag. Nat. Hist., (8), xi, 1913, p. 179. *Id.*, Jordan, Gen. Fish., ii, 1919, p. 170. *Id.*, Waite, Rec. S. Austr. Mus., ii, 2, 1922, p. 215.

Congiopodus vel *Congiopus.*—The confusion which brought about such an imposing array of synonyms as is set forth above is largely due to the great rarity of Perry's "Arcana," which, so far as is known, is the earliest publication including any reference to this genus. In their resumé of Perry's work, Mathews and Iredale record the following note.—

" Plate LV., figuring *Congiopodus percatus*, appears to introduce a new generic name which has not hitherto been noticed."

Being unfamiliar with ichthyological literature, they overlooked Gunther's paper in 1871 (*supra*) in which the validity of *Congiopodus* was discovered in association with *Agriopus*, and Gill's use of Perry's name for a New Zealand species in 1893. Jordan[9] unfortunately quoted *Congiopus* under his notice of Perry's paper, while Waite[10] definitely refers to *Congiopodus* as a mis-spelling. Gunther's notes upon Perry's "Arcana" show clearly that he had a copy of that work before him, while Mr. Iredale informs me that he examined the volume in the British Museum as well as that in Mr. Mathews' library. Under these circumstances, it is evident that *Congiopodus* must be accepted as the name originally used by Perry.

[9]Jordan—Genera of Fishes, ii (Leland Stanford Jr. Univ.), 1919, p. 170.
[10]Waite—Rec. S. Austr. Mus., ii, 2, 1922, p. 215.

Family Gobiidae.

Rhinogobius nebulosus *Forskal.*

Rhinogobius nebulosus (Forskal) McCulloch & Ogilby, Rec. Austr. Mus., xii, 10, 1919, p. 245.

Locality.—Thursday Island; collected by Dr. Paradice.

Distribution.—Northern Australia, from Shark Bay, W. Australia to Cape York and Torres Strait. Specimens in the Australian Museum from Shark Bay, Port Darwin, Cape York, Thursday Island, Murray Island Cooktown, Madras.

Length 117 mm.

Family Blenniidae.

Salarias belemnites *De Vis.*

Salarias nitidus Gunther (part), Fische Südsee, vi, 1877, p. 200, pl. cxiii, fig. g. *Id.*, Seale, Occ. Pap. Bishop Museum, i, 3, 1901, p. 127 (not *S. nitidus* Gunther, Brit. Mus. Cat. Fish., iii, 1861, p. 243, and—part—Fische Südsee, vi, 1877, p. 200, pl. cxiii, fig. f.).

Salarias belemnites De Vis, Proc. Linn. Soc. N.S. Wales, ix, 1884, p. 695.

Alticus evermanni Jordan & Seale, Bull. U.S. Fish. Bureau, xxv, 1905, p. 422.

Identity.—The holotype of *Salarias belemnites*, which is preserved in the Queensland Museum, is a dried skin, very badly filled out, and with all its fins much broken and incomplete. So few specific characters are retained that, in the absence of a second Queensland representative of the species, its identity could not be determined. I now have a fine example, 157 mm. long, from the "Geranium" collection, which I regard as certainly referable to De Vis' species; and comparison with others from Samoa and the New Hebrides further establishes its identity with the species figured by Gunther as *S. nitidus* (part—*loc, cit.*, pl. cxiii, fig. g).

Synonymy.—The name *S. nitidus* was originally based upon Chinese specimens described by Gunther in 1861, in which the margin of the dorsal fin is without a notch between the spinous and rayed portions. Gunther later, 1877, identified Samoan specimens as the same species, although they had a deep notch in the dorsal margin and their colour-marking was somewhat different from that of the Chinese types. He fortunately published notes and figures of both typical Chinese and Samoan specimens in his "Fische Südsee," 1877, p. 200, pl. cxiii, figs. f and g. An examination of these notes and figures led Jordan and Seale to the conviction that two distinct species were represented, and they accordingly proposed the name *evermanni* for the Samoan form. As stated above, however, the Queensland species, *S. belemnites*, 1884, proves to be identical with the Samoan *evermanni*, 1905, and as De Vis' name appeared over twenty years before that of Jordan & Seale, it must take precedence.

Locality.—Gibson Reef, near Townsville, Queensland; collected by Dr. W. E. J. Paradice.

SALARIAS MELEAGRIS *Cuvier & Valenciennes.*

Salarias meleagris (Cuv. & Val.) Gunther, Fische Südsee vi, 1877, p. 208, pl. 116, fig. d. *Id.*, McCulloch & McNeill, Rec. Austr. Mus., xii, 2, 1918, p. 16.

Locality.—Cape Wessel, Arnheim Land; collected by Dr. W. E. J. Paradice.

The species is recorded from Port Darwin and various localities in Queensland south to Caloundra.

Length 124 mm.

Family BATRACHOIDIDAE.

CORYZICHTHYS DIEMENSIS *Le Sueur.*

Batrachus diemensis Richardson, Ichth. " Erebus " & " Terror," ii, 1845, p. 17, pl. viii, figs. 1-2.

Locality.—Port Darwin; collected by Dr. Paradice.

A common species recorded from many localities on the northern Australian coasts, extending southward to Houtman's Abrolhos on the west and Moreton Bay on the east. Specimens are in the Australian Museum from Fremantle, Port Hedland, Port Darwin, Gulf of Carpentaria, Murray Island, and Brisbane River.

It attains a length of 165 mm.

A BRIEF REVIEW OF THE FAMILY *PYGOPODIDAE*.

By

J. R. Kinghorn, C.M.Z.S.

(Figures 1-19.)

Family PYGOPODIDAE, *Boulenger*.

Scincoidiens part, Cuvier, Regne Anim., ii, 1817, p. 61.
Gymnophthalmoidea part, Fitzinger, Classif. Rept., 1826, p. 11.
Autachoglossae part, Wagler, Syst. Amph., 1830, p. 130.
Gymnophthalmi part, Weigman, Herp. Mex., 1834, p. 11.
Scincoidiens part, Dumeril and Bibron, Erp. Gen., v, 1839, p. 511.
Pygopidae Gray, Cat. Liz., 1845, p. 67.
Aprasiidae Gray, loc. cit., p. 68.
Lialisidae Gray, loc. cit., p. 69.
Pygopodidae Boulenger, Ann. Mag. Nat. Hist., (5), xiv, 1884, p. 119.
Ophidiosepsidae Jensen, Vidensk. Meddel., iii, 1900, p. 317.
Pygopodidae Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 15.

Definition of family characters.—Premaxillary single, narrow, and much produced posteriorly between the nasals: in the genus *Lialis* quite as much as in the *Varanidae*. Nasals distinct; frontal single; pre- and post frontals in contact separating the frontal from the orbit (absent in *Ophioseps*); parietals paired except in *Lialis* and *Ophioseps*. Jugal rudimentary; supraorbital bones absent: postorbital or post-fronto-squamosal arch absent. The pterygoids are widely separated and toothless. The mandible contains only four bones the angular, supra-angular and articular having coalesced. Dentition pleurodont, the teeth small closely set, more or less acute and recurved posteriorly. In *Lialis* they are swollen at the base: *Aprasia* has few teeth, *Ophioseps* has them in the lower jaw only, while in the remaining genera they are numerous and of the usual pleurodont type. Skin of head free from cranial ossification.

Body serpentiform, destitute of functional limbs, the forelimbs being entirely absent, while the hind limbs are visible externally as scaly flaps which, are most highly developed in the genus *Pygopus*. When the skin of the hind limb of *Pygopus* is removed the foot, with five ossified bones, may be plainly seen, especially in the males; the ischium appears as a small spur on each side behind the anal cleft. The sternal apparatus is rather rudimentary. Tail long, fragile. Eye small with ellipticovertical or subelliptic pupil, and not protected by moveable lids. Ear exposed or concealed beneath the scales. Tongue elongate, fleshy, extensible, papillose and more or less feebly nicked at the tip. Body

covered with roundish imbricate scales, head covered with regular plates except in *Lialis* where the plates are broken up into small scales. Preanal pores either present or absent.

General review.—The genera reviewed in detail include *Pygopus*, *Delma*, *Pletholax*, *Ophidiocephalus*, and *Cryptodelma*; the latter name proves untenable, a new name *Paradelma* has been added in its place, as will be shown further on. The genera, *Lialis*,[1] *Aprasia* and *Ophioseps*,[2] were reviewed elsewhere, but they have been incorporated in the specific and generic keys, and the figures reprinted herein so that, the paper may be a more or less complete reference for those zoologists who wish to do further research on the family.

The genus *Delma*, as founded by Gray, was separated from others of the family mainly through the absence of preanal pores and the presence of smooth scales, whereas *Pygopus*, of Merrim, possessed more than eleven preanal pores and the scales of the dorsal surface were keeled, while Fischer's genus *Cryptodelma* possessed, or was supposed to possess, smooth scales on the dorsal surface, but had preanal pores. Fischer founded his genus *Cryptodelma* (*sp. nigriceps*) on a single specimen which, in addition to being withered, possessed abnormal scaling, as a glance at his figure will show (reproduced here).

A second species, described by Gunther as *Delma orientalis* was later correctly placed by Boulenger and others as *Cryptodelma orientalis*, and the keys of all authors prior to my investigations divided the genera concerned as follows :—

A. Preanal pores present.
Scales keeled ... ... *Pygopus*.
Scales smooth ... ... *Cryptodelma*.

B. Preanal pores absent.
Scales smooth ... ... *Delma*.

Upon examining a very large series of specimens and comparing them with the various descriptions. as well as one with the other, I find that a certain *group of characters*, such as a distinct type of scaling on the head, the number of scales round the body, the degree of keeling on the scales, and the presence, absence, or number, of preanal pores are the most important external characters by which the genera can be safely divided.

The very distinct types of head shields gave me the clue by which I found it comparatively easy to sort the specimens before me into large heaps, and an examination then showed that, generally, a different type of head scaling meant a separate genus or species as the case may be. One of the most outstanding types among the commoner species is that possessed by *Pygopus*, with its oblique internasals and frontonasals and very conspicuous, low, band-like rostral shield.

[1]Kinghorn—Rec. Austr. Museum, xiv, 3, 1924, pp. 184-188.
[2]Kinghorn—*Loc. cit.*, xiv, 2, 1923, pp. 126-132.

On comparing Fischer's description and figures with those of the various species of *Pygopus*, it will be seen that his species bears a marked resemblance to those belonging to the latter genus, especially as it also possesses a large number of preanal pores and over twenty rows of scales round the body, as well as the typical head shields; furthermore Fischer described the scales of his specimen as being smooth, but in a footnote states "the dorsal scales appear to bear blunt keels, but as the specimen is rather shrivelled, the keels may be due to bad preservation." To my mind this is the key to the situation, but almost as important, and certainly a valuable connecting link, is another species which was described from a single specimen by Boulenger in 1913 as *Pygopus schraderi*,[3] which he separated from *P. lepidopus* on account of the very blunt keels on the scales, and the larger number of scale rows.

On the evidence of Fischer's statement in regard to the blunt keels, supported by the fact that I have a number of specimens of all ages which agree entirely with his description and yet cannot be separated from Boulenger's *Pygopus schraderi*, I feel compelled to admit Fischer's *Cryptodelma nigriceps* into the genus *Pygopus*, and to place *P. schraderi* in the synonymy of that species.

In 1906 Gunther described, from a single specimen, a new species under the name of *Delma bayleyi*, separating it from *C. nigriceps* Fischer by the smaller number of scale rows around the body, it having twenty two as against twenty eight possessed by the latter, but, because of the presence of preanal pores, this species has always been regarded by authors as belonging to the genus *Cryptodelma*, viz :—*C. bayleyi*.

Since the name *Cryptodelma* lapses, concurrent upon the raising of the genotype to the genus *Pygopus*, it has been necessary to consider where *C. bayleyi* Gunther and *C. orientalis* Gunther may be placed. The former species, of which I have examined three perfect specimens from the South Australian Museum, bears a type of scaling, head shields, preanal pores, etc., typical of the genus *Pygopus*, but it has distinctly smooth scales, so I have placed it in the latter genus under the name *Pygopus bayleyi*. In regard to *C. orientalis* Gunther I find no difficulty, as it differs consistently and markedly from *Pygopus*, *Delma*, or any other genus in the family, and as its original generic name ceases to exist I suggest a new name *Paradelma*, and describe it as such, further on in the paper.

The remaining genera belonging to the family are distinct and easily separable, and apart from including them in my key, which will give the main or perhaps the essential characters by which they may be separated, I feel that there is no need at the present juncture to give details concerning their characters.

Key to the genera :—

A. Head covered with large symmetrical plates.
  aa. Preanal pores present.
    1. 10 to 16 preanal pores, frontal much longer than prefrontal ... *Pygopus*.
    2. 4 preanal pores, frontal much smaller than prefrontal ... *Paradelma*.
  bb. Preanal pores absent.

[3]Boulenger—Ann. Mag. Nat. Hist., (8), xii, 1913, p. 564.

c. Parietal shields present, large.
  1. Body scales smooth.
    Ear visible, ventral scales enlarged ... ...*Delma.*
    Ear not visible, ventrals and dorsals subequal *Ophidiocephalus.*
  2. Body scales with two keels on each scale ... ... *Pletholax.*
d. Parietal shields absent.
  1. parietal bone single, frontal bone reaching the orbit ... *Ophioseps.*
  2. parietal bones paired, frontal separated from the orbit by pre and postfrontal bones ... ... *Aprasia.*

B. Head covered with small scales.
    parietal bone single ... ... *Lialis.*

PYGOPUS *Merrem.*

Bipes Lacepede, An. Mus. Paris, iv. 1804, p. 209.
Sheltopusik (non Latr.) Oppel, Ordn., 1811, p. 40.
Hysteropus Dum. et Bibron, Erp., Gen., v, 1839, p. 826.
Pygopus Blgr., Brit. Mus. Cat. Liz., i, 1885, p. 240.*Id.*, Werner, K. Pr. Akad. Wiss, Berlin, Das Tierreich, Leif. 33, 1912, p. 17.

Generic description.—Teeth in both jaws. Parietal bones paired. Tongue slightly nicked at the tip, with rows of large papillae inferiorly. Snout rounded, head covered with large symmetrical plates, frontal much larger than the prefrontal. Ear opening exposed. Scales cycloid, hexagonal, imbricate, eleven to thirteen rows on the dorsal surface with each scale bearing a single keel. The two median series on the abdominal surface, and the median subcaudals hexagonal, transversely enlarged. Rudiments of hind limbs externally, large. Ten to sixteen preanal pores.

Distribution.—Almost the whole of Australia and Tasmania.

Key to the Species :—

Scales more or less keeled.
    Keels sharp ... ... *lepidopus.*
    Keels blunt ... ... *nigriceps.*
Scales smooth ... ... *bayleyi.*

PYGOPUS LEPIDOPUS *Gray.*

Pygopus lepidopodus Gray, Cat. Liz., 1845, p. 67.
Pygopus lepidopus Blgr., Brit. Mus. Cat. Liz., 1885, p. 240. *Id.*, Werner K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 17.

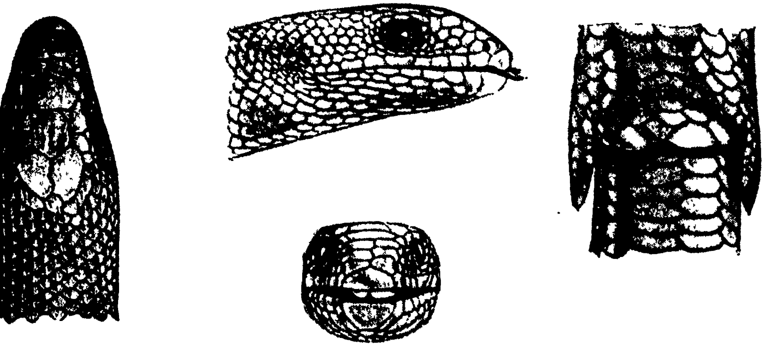


Fig. 1. *Pygopus lepidopus* Gray (after McCoy).

Definition of the species.—Snout rounded, as long as the distance between the orbit and the ear, and about equal to the distance between the posterior border of the orbits. Canthus rostralis obtuse; eye small, completely surrounded by a distinct scaly, ring-like lid. Ear opening smaller than the eye.

Rostral low, band like, two and one half to three times as broad as high. Nostril pierced between the first labial, two nasals, and a fronto-nasal. Anterior nasals much broader than deep, meeting on the centre line of the snout; posterior nasal lying on the upper labial. Two pairs of frontonasals behind the anterior nasal, both pairs broader than deep, the posterior pair being the largest.

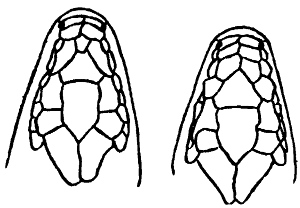


Fig. 2. *Pygopus lepidopus* Gray. Extreme variations in the head shields.

Often there are small azygous shields irregularly placed on the upper parts of the head among the more regular ones. A large polygonal prefrontal about twice as broad as deep, broadly pointed in front and usually convex along its posterior border which joins the frontal; the frontal is irregular in shape and about once and one half as long as broad; it is usually broader in front than behind but the lateral sides may be parallel, converging posteriorly, or slightly constricted in the centre; the posterior angle is wedged in between a pair of large parietals which may or may not be bordered by several enlarged occipital scales. A pair of large supraoculars separated from the eyelid by a row of smaller scales. An enlarged preocular forms a suture with the lateral border of the prefrontal, and is separated from the orbit by a number of small scales which extend forward in the loreal region to the postnasal. Seven or eight upper labials, the fourth or fifth under the eye and separated from the orbit by a single row of scales. Mental large, trapezoid. Four to seven lower labials, the first pair much enlarged. Body scales strongly keeled on the dorsal surface, the keels forming regular lines on the body, but alternate ones on the tail, 20 to 24 rows of scales round the body, the costals larger than the dorsals, ventrals paired, transversely enlarged, in 68 to 85 rows. Two enlarged anal scales separated from the preanal pores by one or two irregular rows of smaller scales. There are from 10 to 16 preanal pores (9 in one exceptional case), the general number ranging from 10 to 12.

Tail when intact one and one half to three times as long as the head and body. Total length of specimens examined from 200 to 650 mm.

Colour (in spirits).—The colour varies considerably, but most generally is uniform reddish brown to olive above, the lower surfaces lighter and often marbled with grey. Some specimens are very brightly

marked with longitudinal series of blackish dots or black quadrangular spots edged with white.

Localities.—Over eighty specimens were examined from various localities throughout Australia. This species is very common in New South Wales.

PYGOPUS NIGRICEPS *Fischer.*

Cryptodelma nigriceps Fischer, Arch. Naturg., xlviii, 1882, p. 290, pl. xvi, figs. 5-9. *Id.*, Blgr., Brit. Mus. Cat. Liz., i, 1885, p. 242. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief, 33, 1912, p. 19.

Pygopus schraderi Boulenger, Ann. Mag. Nat. Hist., (8), xii, 1913, p. 564.

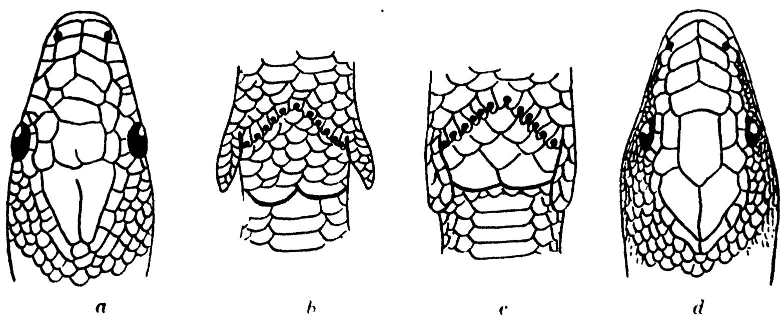


Fig. 3. *Pygopus nigriceps* Fischer. *a* and *b* enlarged from Fischer's original drawing; *c* and *d* from a specimen in the Australian Museum.

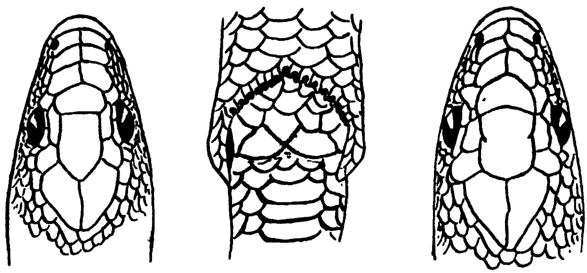
Definition of specific characters.—Rostral shield broad, low and band like. Nostril pierced between the first supralabial and two nasals, the anterior pair of which is much broader than deep, and forms a suture on the snout. Two pairs of frontonasals, the anterior pair being the smallest.

Prefrontal broader than deep, pentagonal, the anterior sides forming a strong point forwards, the posterior side being convex and forming a suture with the frontal which is longer than broad, but not longer than its distance from the rostral; it is pentagonal, the lateral sides usually converging slightly backwards, the posterior sides forming a point and being wedged in between the parietals. Two large supraoculars separated from the orbit by three or four scales. Parietals much longer than broad, as long as the frontal, and bordered by several enlarged occipital scales. A large preocular forming a suture with the anterior supraorbital, the prefrontal, the posterior frontonasal, and several small scales which lie between the orbit and the nasal, thereby separating the upper head shields from the upper labials.

The ring of small scales which borders the eye is visible only on the anterior, posterior and inferior sides. Six or seven upper labials, the fourth under the eye. Mental large, trapezoid, followed by six to eight

lower labials, the first pair of which does not form a suture behind the mental. Body scales very bluntly keeled, the keel in some cases being so blunt as to resemble a longitudinal hump, while in the young it is indistinct to the naked eye. Body scales in 22 to 29 rows, the laterals larger than the dorsals, the ventrals paired, broader than long, and arranged in 80 to 97 pairs.

Two large anal scales separated from the preanal pores by a number of smaller scales. Twelve to sixteen preanal pores.



a b c

Fig. 4. *Pygopus nigriceps*, Fischer, variations in head shields and preanal pores; *a* has twelve, and *b* and *c* sixteen preanal pores.

Colour (in spirits).—Brownish above, cream below. Head beautifully mottled with dark brown blotches and bands. A broad crescentic band on the nape from ear to ear and two transverse, narrow, irregular ones between the nape band and the eyes. A dark band through the eye, and another on the snout through the nostril to the lower labials. The dorsal surface of the body bears conspicuous dark markings which are bordered with white. The sides are covered with white, dark edged spots, on a greyish ground colour. In some of the young specimens which have been in spirits for a number of years many of the colours are completely lost, while in others the head is so dark as to be almost uniform blackish.

(These young specimens were in the Museum collection for about twenty years under the name *Cryptodelma nigriceps*.)

Holotype from Milparinka, western New South Wales, described from a single specimen 125 mm. in length.

Sixteen specimens were examined ranging in length from 140 mm. to 450 mm., and it was noted that the tail may be as long as or a little longer than the head and body.

Localities:—Laverton, Western Australia; Hughenden, Queensland; and the following localities in New South Wales: Milparinka, Yandenbah, Berowra, Wee Waa, Hillston, Mullingudgery, Jerilderie, Sydney, Wentworth, and an unknown place on the Darling River.

PYGOPUS BAYLEYI *Gunther*.

Delma (*Cryptodelma*) *bayleyi* Gunther, Ann. Mag. Nat. Hist., (6), xix, 1897, p. 170, figs. 1-3.

Cryptodelma bayleyi Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 20.

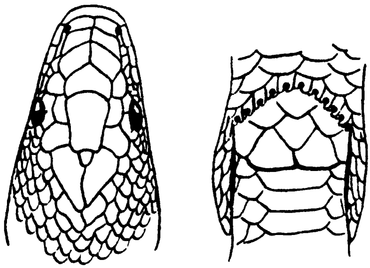


Fig. 5. *Pygopus bayleyi* Gunther. A smooth scaled species.

Definition of specific characters.—Rostral shield broad, low, band-like, nostril between three shields, the first labial and two nasals. The anterior nasals larger than the posterior and forming a suture on the median line behind the rostral. Two pairs of frontonasals, broader than long, the posterior pair being the larger. Prefrontal pentagonal, twice to thrice as broad as long, slightly variable in shape, pointed in front and concave behind, the posterior border forming a suture with the frontal which is five-sided, nearly twice as long as broad, the lateral sides parallel, or converging or diverging slightly posteriorly, so that it may be either broader or narrower in front than behind.

The posterior borders form a blunt point which is wedged in between the parietals. Two large supraoculars and a preocular separated from the orbit by several small scales. The ring-like eyelid is not visible on the superior side. A number of small scales between the orbit and the posterior nasal separate the upper head shields from the upper labials, which are seven in number, the fourth being under the eye. Parietals longer than broad, pointed posteriorly, and bordered by several enlarged occipital scales. Mental large, followed by seven lower labials. Body scales smooth, in 22 longitudinal rows; ventrals transversely enlarged, arranged in 89 to 120 pairs. Ten to fourteen preanal pores separated from a pair of enlarged preanal scales by about six smaller scales. Rudimentary hind limbs, in the males, about equal in length to the distance between the snout and the centre of the frontal shield.

Colour (*in spirits*).—Yellowish olive, the edges of the scales darker and thus forming a network pattern all over the upper surface. The lower parts are whitish, and there are diagonal, dark areas on the sides. Crown of head, and a broad band across the neck, blackish with a pair of red or yellowish spots on the nape. A black band descends from the eye and another from the nostril to the lower labials.

Holotype from Cue, Western Australia. Described from a single specimen 160 mm., in length, tail 90 mm.

Five specimens were examined measuring from 180 to 290 mm. in length.

Localities.—Holotype and three other specimens from South West Australia; two from Tennant's Creek, South Australia and one from Everard Range, South Australia.

PARADELMA *nom. nov.*

Cryptodelma part, Boulenger, Brit. Mus. Cat. Liz., i, 1885, p. 242.

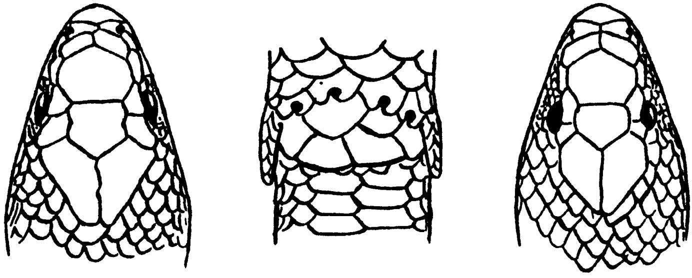
Parietal bones paired. Tongue elongate, fleshy, slightly nicked at the tip, papillae of upper surface minute at the free end, large at the base, and large, round and flat, on the under surface.

Ear exposed, minute. Rudimentary hind limbs visible externally, about as long as the snout. Head with large symmetrical shields, pre-frontal much larger than the frontal. Scales smooth, cycloid, imbricate, costals larger than the dorsals. Ventrals paired, in 95 to 109 rows, the subcaudals single, transversely enlarged, hexagonal. Two enlarged preanal scales. Four preanal pores.

Distribution.—Probably restricted to Queensland.

PARADELMA ORIENTALIS *Gunther.*

Delma orientalis Gunther, Journal Mus. Godeff., xii, 1876, p. 45.
Cryptodelma orientalis, Boulenger, Brit. Mus. Cat. Liz., i, 1885, p. 242, pl. xix. *Id.*, Werner, K. Pr. Akad. Wiss., Berlin, Das Tierreich, Lief. 33, 1912, p. 20.



a *b* *c*

Fig. 6. *Paradelma orientalis*, Gunther (Nom. Novum) *a-b*, from a specimen in the Australian Museum, *c* after Boulenger.

Definition of the species.—Snout rounded, as long as, or slightly shorter than, the distance between the orbit and the ear, canthus rostralis broadly rounded. Eye with an indistinct, circular scaly lid, ear opening

small, oval, oblique, directed backwards, very much smaller than the eye, about as large as the pupil, which is vertical. Rostral pentagonal, about twice as broad as high; nostril pierced between the first labial and two nasals the anterior of which is much the larger, forming a suture with its fellow behind the rostral. A pair of frontonasals forming a suture on the centre line of the snout, and bordering the nasals, loreal and prefrontal. Prefrontal seven sided, much larger than the frontal, longer than its distance from the end of the snout, broader than long and broader than the length of the frontal, its anterior and posterior sides concave. Frontal small, nearly as broad as long, its greatest width about equal to the depth of the prefrontal. Two large supraorbitals, the first bordering the orbit, the second separated from the orbit by two small scales. A large loreal also separated from the orbit by two small scales. There are six rather deep upper labials, the fourth under the eye, and they are separated from the head shields by a row of small scales. Parietals large, their greatest length equal to the distance from the frontal to the tip of the snout. Mental trapezoid, broader than long, four or five lower labials, the first two on each side very large, the second being the largest, the first pair not meeting behind the mental.

Body scales smooth, in 18 to 20 longitudinal rows, including the ventrals which are about twice as broad as long, and in 97 to 110 pairs.

Two enlarged anal scales, and a row of four smaller scales between them and the perforated preanals. Four preanal pores. Tail a little longer than the head and body; the caudal scaling is comparable to that of the body, but the subcaudals are in a single row.

Colour (in spirits).—Light brown above with a series of longitudinal dark lines; lighter below. A dark patch surrounds the eye and extends to the temporals, and there is a broad dark nuchal collar. The measurements of the holotype, as given in the British Museum catalogue, are, head 13 mm., width of head 9.5 mm., body 185 mm., tail 175 mm., hind limb 5 mm. The Australian Museum specimen from which this description was partly drawn up measures:—head 13 mm., width of head 8.5 mm., body 135 mm., tail 170 mm., hind limb 4 mm.

Localities.—The holotype, which is in the Godeffroy Museum, Hamburg, came from Peak Downs, Queensland; while of two other specimens in that museum one is from Peak Downs, and the other from Gayndah, Queensland.

The specimen in the Australian Museum (figured) has no data attached to it.

DELMA *Gray*.

Delma Gray, Zool. Miscell., 1831, p. 14.

Nisara Gray, Liz. Austr., 1867, p. 3.

Pseudodelma Fischer, Arch. Naturg., xlviii, 1882, p. 286.

Delma Boulenger, Brit. Mus. Cat. Liz., 1, 1885, p. 243. *Id.*, Werner. K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 21. *Id.*, Longman, Mem. Qld. Mus., v, 1916, pp. 50-51.

Generic description.—Teeth in both jaws. Parietal bones paired. Tongue slightly nicked at the tip and with rows of large round papillae inferiorly. Snout rounded, head covered with large symmetrical shields. Ear exposed. Scales cycloid, hexagonal, imbricate, smooth, the two median series on the abdominal surface and the median subcaudals hexagonal, transversely enlarged. Rudiments of hind limbs present, small. No preanal bones.

Distribution.—Australia generally.

General.—Mr. Longman suggested that there was a considerable degree of variation in certain characters by which this genus might be divided up into species, and he mentioned especially the upper labials, pointing out that the second has a tendency to divide and that the third or fourth may be found to be situated under the eye, as the case may be. He also mentioned the number of scales around the body, and the fact that in some specimens of *D. fraseri*, the first upper labial fuses with the lower part of the nasal. He ended by regarding "*reticulata* as a synonym, and *tincta* and *plebeia* as but variations of *D. fraseri*." He leaves *D. lineata* (which has the anterior part of the nasal fused with the first upper labial) as a distinct species, and I agree with him that this is a very good character.

Longman's deductions have been a very valuable aid to me in the compilation of this paper, as also have been his remarks during some correspondence I have had with him. His was the first attempt of the kind, in relation to the synonymy of this complicated group, and I am sure that had he the large series of specimens which were available to me he would have arrived at the conclusions which I am about to express.

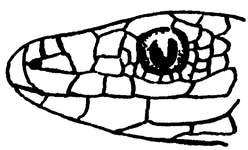


Fig. 7. *Delma fraseri*, Gray, showing the frontonasal reaching the second upper labial; an abnormality which occurs in several of the specimens examined.

An examination of between eighty and one hundred specimens belonging to this genus has convinced me that a certain *combination of characters* can be found, by which the species may be consistently separated. Of course there are abnormal specimens but the combination of characters chosen will not be completely upset, and any specimen can be easily placed in the species to which it rightly belongs.

The typical specimens have the following characters :—

Frontonasals	Labial under eye	Scale rows	Anals	Species
2	4	16	3	*fraseri*
2	4	14–16	2	*fraseri* var. *plebeia*
1	3	14	3	*tincta*
1	4	14–16	2	*impar*

In addition to this formula it might be added that *D. fraseri* and *fraseri* var. *plebeia* have the snout as long as the distance between the eye and the ear, while in *D. tincta* and *impar* the snout is shorter than the distance between the eye and ear. *D. impar* differs further from *D. tincta* in having the nasal and the rostral shields fused.

Key to the genus *Delma* :—

A. One pair of frontonasals, the snout shorter than the distance between the eye and ear.
   1. Nasal and rostral fused, 4th labial under eye, 2 anal scales ... *impar*.
   2. Nasal and rostral not fused, 4th labial under eye, 3 anal scales ... *tincta*.

B. Two pairs of frontonasals, the snout longer than the distance between the eye and ear.
   Three anal scales ... ... *fraseri*.
   Two anal scales ... ... *fraseri* var. *plebeia*.

Delma fraseri *Gray*.

Delma fraseri Gray, Zool. Miscell., 1831, p. 14, and in Grey's Travels in Australia, ii, p. 487, pl. iv, fig. 3. *Id.*, Blgr., Brit. Mus. Cat. Liz., iv, 1885, p. 243. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 21. *Id.*, Longman, Mem. Qld. Mus., v, 1916, p. 50.

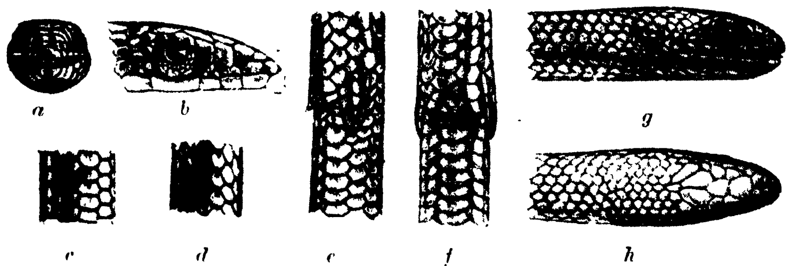


Fig. 8. *Delma fraseri*, Gray.—*a*, Rostral area; *b*. side of face; *c*, ventral scales; *d*, dorsal scales; *e* and *f*, lateral and ventral views of anal area; *g* and *h*, lateral and dorsal view of head and neck.

Definition of the species.—Snout obtuse, as long as the distance between the orbit and the ear. Canthus rostralis obtuse, eye with distinct circular scaly lid. Rostral triangular or pentagonal, about once and one half to twice as broad as high. Nostril generally pierced between the first upper labial, two nasals and the anterior frontonasal. Nasals divided,

the anterior pair forming a suture on the snout behind the rostral. Two pairs of frontonasals. Prefrontal seven sided, broader than long, the antero-lateral sides shortest, and in contact with a large loreal. Frontal about as broad as, and generally larger than, the prefrontal, seven sided, longer than broad, its posterior angle wedged in between the parietals which are (except in abnormal specimens) much larger and longer than the frontal.

The occipital scales may be irregular and broken up, or there may be two or three elongate ones bordering the parietals. Ear opening smaller than the diameter of the eye. Five or six upper labials, the fourth elongate and situated under the eye from which it is separated by a row of small scales. Four or five lower labials, the first pair forming a suture behind the mental which is triangular. broader than long, and larger than the rostral. There are 16 rows of scales round the centre of the body (including the ventrals), the ventrals are enlarged, usually much broader than long, and arranged in 45 to 61 pairs. Three preanal scales, the central one being triangular and the smallest.

Colour (in spirits).—Uniform dark to light brown above and cream below, or dark grey above and below. Top of head and sides of neck mottled, under side of chin and neck creamy white, bearing irregular dark bands.

Some specimens are light brown above, and cream or white below, the nape and head being blackish brown, with three or four distinct narrow, light cross bars ; the dark areas of the head extending downwards to the level of the lower jaw, and forming more or less blunt points.

Localities.—Of the fifty specimens examined about half of them came from localities situated between Derby, North Western Australia, and south of Perth, Western Australia. Four are from South Australia as follows :—407 miles, East-West Line ; Waikerie ; and Central Australia. Eight are from New South Wales, Albury, and Cootamundra in the south and Narromine in the west. Several specimens are from Port Darwin, North Australia. The holotype is from Western Australia.

DELMA FRASERI *Gray*, var. PLEBEIA *De Vis*.

Delma plebeia De Vis, Proc. Linn. Soc. N.S.W. (2), ii, 1888, p. 824.
Delma fraseri part, Longman, Mem. Qld. Mus., v, 1916, p. 50.

I have examined two specimens of this variety, one of which was De Vis' type of *D. plebeia*, and cannot find any specific difference between it and *D. fraseri*, even though De Vis stated in his paper that " there are sufficient constant differences from *D. fraseri* to lead us to regard it as more than an eastern variety of that species."

During my examination of the type I found that De Vis had made several minor mistakes in his description.

The snout is as long as the distance between the eye and the ear. There are from 14 to 16 rows of scales round the body, 50 to 55 ventrals, and two enlarged preanal scales.

The only difference I can find between the two forms is that *fraseri* has 16 rows of scales round the body and 3 anal scales, while var. *plebeia* has from 14 to 16 body scales and 2 anal scales, and I cannot consider this sufficient grounds on which to regard them as separate species.

Distribution.—As far as is known the variety appears to be restricted to Queensland.

Delma tincta *De Vis.*

Delma tincta De Vis, Proc. Linn. Soc. New South Wales, (2), ii, 1888, pp. 824-825.

Delma reticulata Garman, Bull. Mus. Comp. Zool., Harvard, xxxix, 1901, p. 5, pl. 2, figs. 1-1f. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 23.

Delma fraseri (part) Longman, Mem. Qld. Mus., v, 1916, p. 50-51.

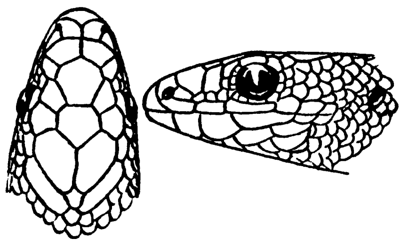


Fig. 9. *Delma tincta* De Vis, figured from the Holotype in the Queensland Museum.

Definition of the species.—Snout obtuse, canthus rostralis obtuse, rounded. Nasal divided into an anterior and posterior portion. Rostral triangular, about two thirds as high as broad, nostril pierced between the divided nasal and the first labial, the anterior nasals forming a suture on the snout. Prefrontal larger than the frontal, seven sided and usually longer than broad. Frontal seven sided about as broad as long, square across the anterior border, pointed posteriorly.

One pair of frontonasals, two supraoculars, below which are three supracilliaries. A large loreal separated from the orbit and the upper labials by several small scales. Parietals as large as, or larger than, the prefrontal, and bordered by a band like occipital scale. Five or six upper labials, the third elongate, situated under the eye.

Four lower labials the anterior pair forming a suture behind the mental which is large, triangular and a little broader than long.

Ear opening about half the diameter of the eye, the distance between the eye and the ear greater than that from the eye to the end of the snout. Scales round the body in 14 longitudinal rows, ventrals much larger than the dorsals, about twice as broad as long, arranged in 48 to 55 pairs. Three enlarged preannal scales, the central one smallest, triangular. Rudimentary hind limb shorter than the snout.

No preanal pores. Measurements of the holotype, head 6 mm., body 31 mm., tail 136 mm.

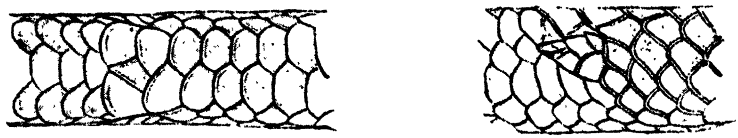


Fig. 10. *Delma tincta* De Vis, anal area (from Garman's figure of *D. reticulata*).

Colour (*in spirits*).—Light brown to grey on the dorsal and creamy white on the ventral surfaces. The upper and lateral parts of the head and nape dark brown, almost black, crossed with transverse, narrow white bands. The first band is immediately in front of, and the second behind, the eyes, the third is from ear to ear and the fourth across the nape. The tip of the rostral is whitish and there are white patches on several of the upper labials. The dark areas extend to below the level of the mouth and ears, forming obtuse points on the sides of the lower jaw. The scales of the dorsal surface have dark edges thereby forming reticulations, but this is not visible in all specimens.

Localities.—Six of the ten specimens examined came from Queensland:—Normanton (holotype), Oakley, Darling Downs, Cooktown, Bloomfield River, Mt. Barren Range, and Roma.[4]

One specimen is from the Clarence River, N.S. Wales, and one from "Mt. Barker," but whether this locality refers to the Mt. Barker near Adelaide or Perth I am unable to say. Among the specimens from the W.A. Museum is one labelled "West Australia," and if the locality is correct, it greatly increases the range of this species, which previously was considered to be restricted to Queensland and north eastern New South Wales.

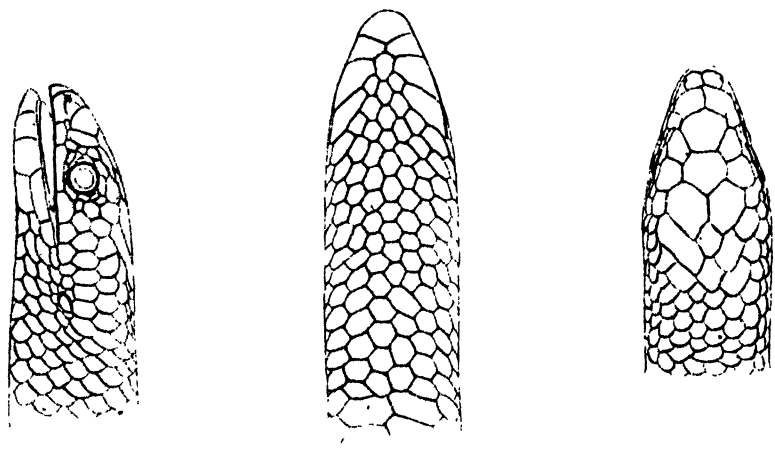


Fig. 11. *Delma tincta* De Vis. (From Garman's figure of *D. reticulata*).

[4]Macleay—Proc. Linn. Soc. N.S. Wales, x, 1885, p. 62.

Note.—When Garman described *D. reticulata* as a distinct species he may not have been aware of De Vis' species, as Longman suggests; but upon examining the holotype and comparing it with the description I find that, as there were some outstanding mistakes, Garman could have been excused for supposing his specimen to be distinct.

DELMA IMPAR *Fischer.*

Delma impar Fischer, Arch. Naturg. Berlin, xlviii, 1882, p. 287, pl. xvi, figs. 1-4. *Id.*, Blgr. Brit. Mus. Cat. Liz., i, 1885, p. 244. *Id.*, McCoy, Prod. Zool. Vic., ii, 1888, p. 235, pl. clxii, fig. 2. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 23.

Delma lineata Rosen, Ann. Mag. Nat. Hist., (7), xvi, 1905, p. 131, pl. viii, fig. 1, and text figures.

Delma fraseri (part) Longman, Mem. Qld. Mus., v, 1916, p. 51.

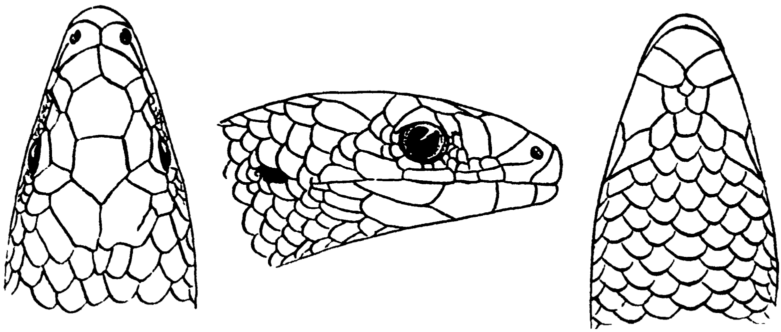


Fig. 12. *Delma impar* Fischer. From a specimen in the Australian Museum.

Definition of the species.—Snout truncate, a little shorter than the distance between the orbit and the ear opening. Tail twice or sometimes two and one quarter times as long as the head and body. Rudimentary hind limbs small, shorter than the snout. Rostral triangular. broader than deep. Nostril pierced in the lower portion of a semi divided nasal which forms a suture with its fellow on the snout, the anterior part being fused with the first upper labial. Only one pair of frontonasals. The prefrontal is seven sided and broader than long. The frontal is longer than broad, usually smaller than, but may be as large as, the prefrontal; it varies slightly in shape, and the posterior borders form a sharp point which is wedged in between the parietals. Two supraorbitals, and a large loreal; a row of small scales separating the loreal from the orbit; Parietals almost as large as the frontal and prefrontal combined. Seven upper labials, the fourth narrowest, elongate and situated below the eye, from which it is separated by a row of small scales. Mental large, triangular, broader than long. Five or six lower labials, the first pair forming a suture behind the mental, or separated by a small scale. Body scales

in 14 to 16 rows, the ventrals larger and broader than the dorsals. Two enlarged anal scales. No preanal pores.

Colour (*in spirits*).—Brownish above and creamy white below. Two light coloured, dark edged lines running from the nape to the anterior part of the tail, the rest of the upper and lateral parts of the tail bearing oblique light and dark lines.

This description is compiled from six specimens, and the original descriptions of *D. impar* and *D. lineata.*

Localities.—The holotype is from Melbourne, Victoria, and Rosen's type from Victoria, no definite locality. The specimens examined came from Port Lincoln, South Australia; Maryborough, Victoria; and Cooma, New South Wales.

Comparative and general.—In describing *D. lineata*, Rosen separated it from *D. impar* on the following points:—Sixteen rows of scales round the body; first lower labial not in contact with its fellow; frontal larger than the prefrontal, anterior part of nasal fused with upper labial.

On examination of the specimens available I find that the scale rows vary from 14 to 16, the first lower labial may be in contact with its fellow or separated from it by a small scale, the frontal may be anything from a little smaller to a little larger than the prefrontal, but the anterior part of the nasal is fused with the first upper labial. The above characters appear to have no fixed relationship with each other and they vary slightly in individual specimens so no combination can be found that would satisfactorily separate them. Both were described from single specimens and therefore leave the possibility of abnormalities being mistaken for specific characters. For example, one specimen with six lower labials has the first pair in contact behind the mental, while in another they are separated by a very small azygous scale, both of these have 16 rows of scales round the body. One with five and another with six lower labials each have the first pair in contact, but one has 14 and the other 16 rows of scales round the body. The fusing of the first upper labial with the anterior part of the nasal is a splendid and constant character in all my specimens; one possessed also by Rosen's *D. lineata.* As Fischer's specimens agree in all other respects, I have taken the liberty of assuming that he overlooked this, and that the two belong to the same species.

OPHIDIOCEPHALUS *Lucas and Frost.*

Ophidiocephalus Lucas and Frost, Proc. Roy. Soc. Vic., n.s., ix, 1897, p. 54. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 24.

Parietal bones paired. Tongue nicked at the tip and bearing six longitudinal papillose ridges inferiorly. Rudiments of hind limbs externally. Head with large symmetrical plates. Eye minute; ear not

visible externally. Scales smooth, cycloid, hexagonal, imbricate subequal; abdominal scales not enlarged. No preanal pores.

Distribution.—Appears to be confined to Central Australia.

OPHIDIOCEPHALUS TAENIATUS *Lucas and Frost*

Ophidiocephalus taeniatus Lucas and Frost, Proc. Roy. Soc. Vic., n.s., ix, 1897, p. 54. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 24.

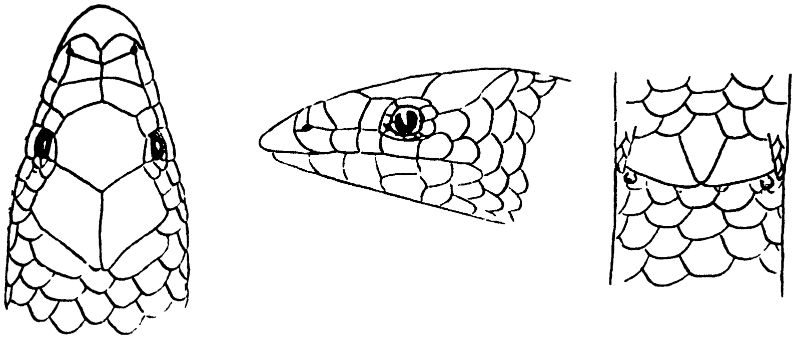


Fig. 13. *Ophidiocephalus taeniatus*, Lucas & Frost, figured for the first time from the Holotype in the National Museum, Melbourne.

Definition of the species.—Snout prominent, depressed, as long as the greatest width of the parietals. Canthus rostralis rounded, indistinct. Eye very small, covered by a transparent scale (as in the *Ophidia*) pupil circular, there is no eyelid, but the scales round the orbital space are small, those on the posterior border being the largest. Ear hidden. Rostral large, much broader than long, extending well back on the upper surface of the snout. Nostril minute pierced between the nasal, frontonasal and the first upper labial. Nasals small narrow, bandlike, forming a suture on the snout. Frontonasals forming a short suture on the snout, but a longer one with the first upper labial. A pair of large prefrontals, larger than the nasal and frontonasal combined, and forming a suture with the second upper labial. Frontal large, octagonal, as long as broad, not as long as its distance from the snout, longer than the suture formed by the parietals. A large preocular forming a suture with the frontal, prefrontal and third upper labial. There is no true supraocular, the frontal being separated from the eye by one of the ring of small scales which border the orbital area. Parietals large, bordered by two enlarged occipitals which are separated on the median line by a small scale. Six upper labials, the fourth under the eye. Mental large, trapezoid; five lower labials, the first pair small, narrow, not meeting behind the mental, second pair the largest.

Sixteen longitudinal rows of scales round the body, subequal. Three enlarged anal scales, the central one smallest, triangular. Rudimentary

hind limbs very small, about as long as the distance between the eye and the nostril. Tail about once and one half as long as head and body. Head 8mm., width of head 4.5 mm., body 94 mm., tail 160 mm., hind limb 2.5 mm.

Colour (*in spirits*).—Dorsal surfaces creamy white, lateral and under parts brownish, each scale edged with creamy white.

Locality.—Holotype from Charlotte Waters, Central Australia; the specimen is unique.

Redescribed and figured from the holotype.

PLETHOLAX *Cope*.

Pletholax Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 229. *Id.*, Blgr., Brit. Mus. Cat. Liz., i, 1885, p. 245. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 19.

Parietal bones paired. Head very long, narrow, depressed, covered with large symmetrical shields. Eye large, ear minute, very much smaller than the pupil of the eye. Dorsal scales rounded, larger than the ventrals, all the scales bearing two distinct keels. Rudiments of hind limbs minute. No preanal pores, anal scales much enlarged.

Distribution.—Confined to South Western Australia.

PLETHOLAX GRACILIS *Cope*.

Pletholax gracilis Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 229.
Pygopus gracilis Gunther, Zool. " Erebus " and " Terror," ii, 1875, p. 10.
Pletholax gracilis Blgr., Brit. Mus. Cat. Liz., i, 1885, p. 245. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, Lief. 33, 1912, p. 19.

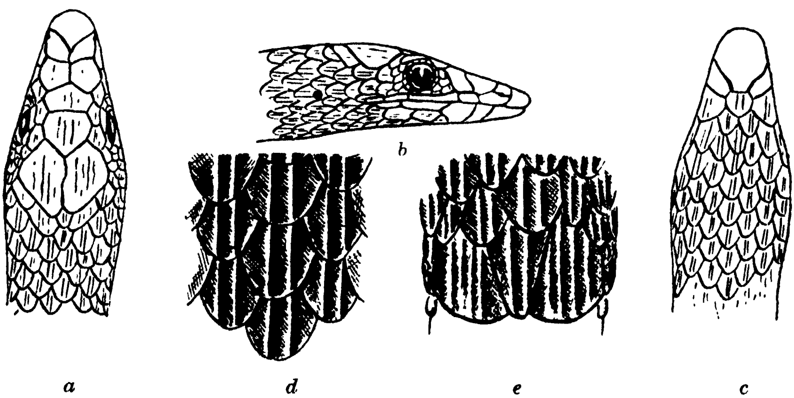


Fig. 14. *Pletholax gracilis* Cope. *a*, dorsal, *b*, lateral, *c*, ventral view of head; *d*, dorsal scales showing paired keels; *e*, anal area. Figured for the first time from a specimen in the Western Australian Museum.

Snout rounded, prominent, depressed, as long as the distance between the orbit and the ear, longer than the distance between the posterior border of the orbits. Canthus rostralis obtuse, rather flattened. Eye large, completely surrounded by a circular, scaly ring-like lid.

Ear opening minute, hardly visible to the naked eye, much smaller than the pupil of the eye. Rostral large, about as long as broad, extending well back on to the snout. Nasals triangular, their shortest edges forming a suture behind the rostral. Nostral minute, pierced between the nasal and the large first labial. A pair of frontonasals and a large loreal or preocular, which is separated from the orbit by several small scales, forming a suture with the second upper labial. Prefrontal seven sided, much broader than long. Frontal seven sided, a little longer than broad, its anterior edge forming a broad suture with the prefrontal, and its posterior sides forming a point, and wedged in between the parietals. Parietals very broad, and as long as the distance between the anterior border of the prefrontal and the tip of the snout. A pair of small supraoculars separated from the orbit by two or three scales. The frontal, parietals and supraoculars bear more or less strong ridges of keels. Five upper labials, the third long, narrow, and situated below the orbit. Mental much larger than the rostral, longer than broad. Four lower labials, the first two pairs transversely enlarged, separated on the median line by a scale, the third long, narrow, situated immediately below the eye.

Scales round the centre of the body in 16 rows; the dorsals, which are rounded, are larger than the ventrals, the latter being more sharply pointed posteriorly. All the scales of the body and tail, dorsal and ventral, bear two keels, with a deep groove between. Ventrals, counting from immediately behind the mental in 70 rows. Rudimentary hind limbs very small, slightly longer than the distance across the orbit.

Three preanal scales, the central one long and narrow, the outer two much the larger and rounded. Head and body 60 mm. Tail 155 mm., width of head 3.7 mm., width of body about 2.5 mm.

Localities.—Holotype from South West Australia. Redescribed and figured from a specimen found near Perth, Western Australia in November or December, 1924.

This specimen appears to be the second one known to science, and is certainly the only specimen at present in Australia (Western Australian Museum), the holotype being in the Academy of Natural Sciences, Philadelphia.

LIALIS *Gray*.

Lialis J. E. Gray, Proc. Zool. Soc. Lond., 1835, p. 134. *Id.*, Kinghorn, Rec. Austr. Mus., xiv, 3, 1924, p. 184.

Parietal bone single; teeth in both jaws, numerous, fairly sharply pointed and recurved posteriorly. Ear exposed. Head covered with small irregular scales. Rudimentary hind limb small. Preanal pores present.

Distribution.—Aru Island, New Guinea and Australia.

Key to the species :—

Tip of snout truncate, rostral quite twice as broad as high. Four preanal pores ... ... *burtonis.*

Tip of snout sharp pointed, rostral slightly broader than high. Six to eight preanal pores ... ... *jicari.*

LIALIS BURTONIS *Gray.*

Lialis burtonis Gray, Proc. Zool. Soc. Lond., 1835, p. 134. *Id.*, Kinghorn Rec. Austr. Mus., xiv, 1924, p. 184, figs. 1-7 (1-4 reproduced below).

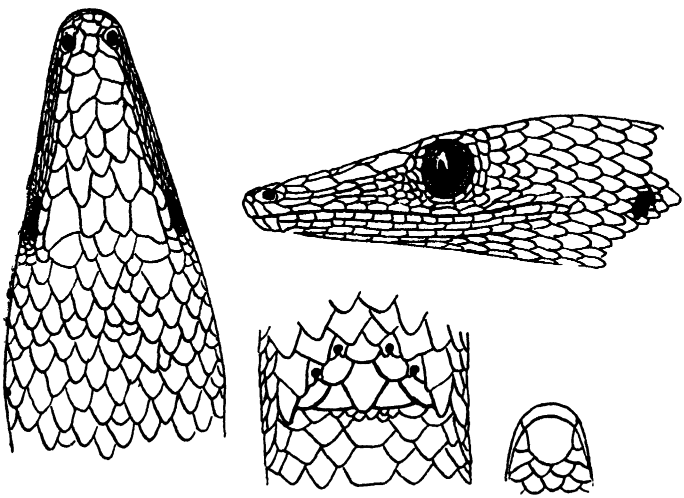


Fig. 15. *Lialis burtonis* Gray.

Head long, narrow, depressed. Canthus rostralis angular. Tip of snout truncate, rostral band-like, twice as broad as high. 19-23 rows of scales round the body, 70 to 100 pairs of ventrals, 5 anals, 4 preanal pores.

Full comparative characters given in the paper quoted above.

Distribution.—From British New Guinea, through many of the islands of Torres Strait to practically the whole of Australia.

LIALIS JICARI *Boulenger.*

Lialis jicari Blgr., Ann. Mag. Nat. Hist., (7), xii, 1903, p. 430. *Id.*, Kinghorn, Rec. Austr. Mus., xiv, 3, 1924, pp. 187-188, figs. 8-11 (reproduced below).

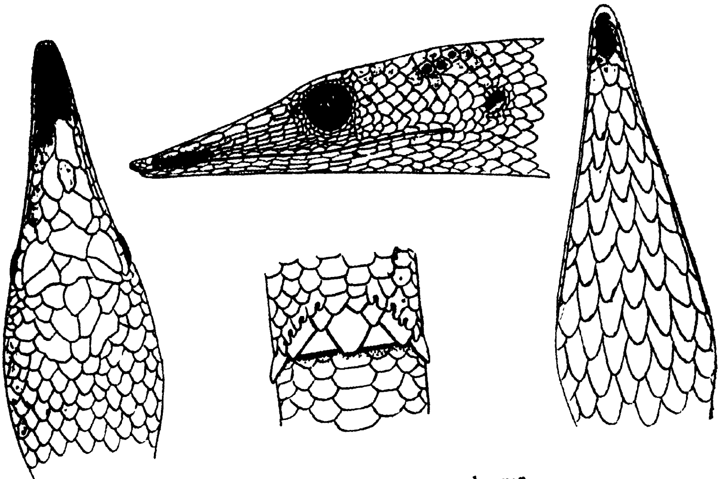


Fig. 16. *Lialis jicari* Boulenger.

This species differs consistently from *L. burtonis* in having a much more sharply pointed and cylindrical snout, and a greater number of preanal pores. The mental is long and narrow. There are 26 rows of scales round the body, the ventrals are in 90 to 114 pairs, anals 5 to 6, preanal pores 6 to 8.

Distribution.—*L. jicari* appears to be restricted to New Guinea and perhaps some of the neighbouring islands.

OPHIOSEPS *Bocage.*

Ophioseps Bocage, Journ. Acad. Lisboa., iv, 1873, p. 231. *Id.*, Kinghorn, Rec. Aust. Mus. xiv, 2, 1923, pp. 126-128, fig. 2.

Differs from *Aprasia* in having the parietal bone single instead of paired.

Distribution.—Restricted to West Australia.

OPHIOSEPS NASUTUS *Bocage*.

Ophioseps nasutus Bocage, Journ. Acad. Lisboa, iv, 1873, p. 232. *Id.*, Kinghorn, Rec. Austr. Mus., xiv, 2, pp. 128-129, figs. 4-6 (reproduced below).

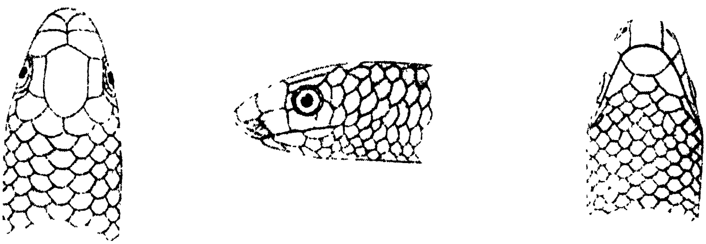


Fig. 17. *Ophioseps nasutus* Bocage. (after Jenson.)

This species was described from a single specimen collected at Lion Mill, Donnybank, Western Australia, and apparently no other specimen has since been found. The external characters and general appearance would tend to place it in the genus *Aprasia*, but the cranial characters, according to Bocage, separate it immediately. Reference to Jensen's figures,[5] will show that the head appears to be slightly shorter and the snout, from a lateral aspect, more pointed than in *Aprasia pulchella*, but in all other external characters the two might be identical. Jensen's figures of the skull are undoubtedly diagrammatic, so much so that it is possible some mistake has occurred, especially in relation to the absence of pre and postfrontal bones. If there is only one specimen in existence, the holotype, have the external characters of the head been sacrificed so that a complete drawing of the skull could be made ? If not, where is the second specimen ?

Locality.—Lion Mill, Donnybrook, Western Australia (holotype).

APRASIA *Gray*.

Aprasia Gray, Ann. Mag. Nat. Hist., ii, 1839, p. 331. *Id.*, Kinghorn, Rec. Austr. Mus., xiv, 2, 1923, p. 129.

Parietal bones distinct, paired. Frontals paired, the pre- and postfrontal forming a suture above the orbital space. Premaxillary teeth present or absent (two microscopic ones on each side of the lower jaw). No preanal pores.

Distribution.—Restricted to South and West Australia.

Key to the species :—

Postocular scale present.
  Premaxillary teeth present ... ... *pulchella.*

Postocular scale absent.
  Premaxillary teeth absent ... ... *repens.*

[5]Jensen—Vidensk. Meddel,. iii, 1900, p. 317, figs. A-C.

APRASIA PULCHELLA *Gray.*

Aprasia pulchella Gray, Annr. Mag. Nat. Hist., ii, 1839, p. 331. *Id.*, Kinghorn, Rec. Austr. Mus., xiv. 2, 1923, pp. 130-132, figs. 7-9 (reproduced below).

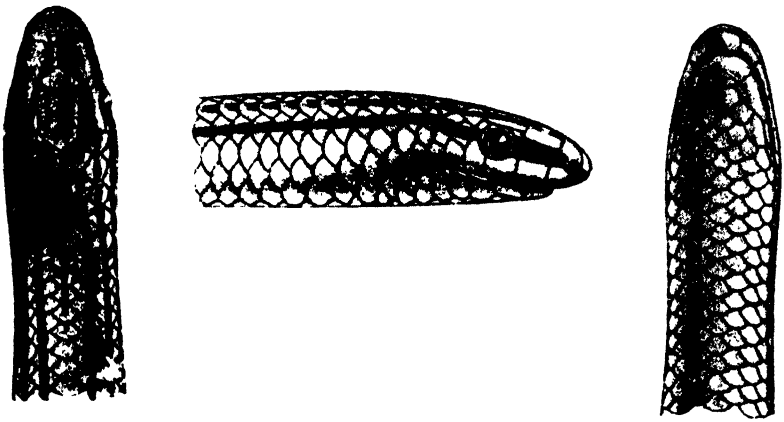


Fig. 18. *Aprasia pulchella* Gray. (after McCoy.)

The main characters by which this species can be readily separated from *A. repens* are given in the key, but in addition, the fourth upper labial is separated from the supraocular by the postocular scale; and the length of the snout from the anterior edge of the eye, is less than three times the diameter of the eye. The nostril is isolated or connected by a suture with the second upper labial.

Localities.—Fourteen specimens examined from West Arthur via Wagin, Western Australia; and Western Australia no definite locality.

Holotype in the British Museum, Natural History.

APRASIA REPENS *Fry.*

Ophioseps repens Fry, Rec. West. Austr. Mus., i, 1912, pp. 178-182, text figs. *Id.*, Kinghorn, Rec. Austr. Mus., xiv, 2, 1923, pp. 132-134, figs. 10-12 (reproduced below).

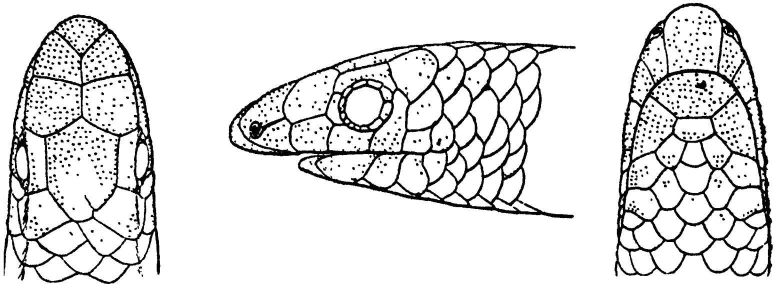


Fig. 19. *Lialis repens*, Fry. (after Fry.)

In addition to the characters given in the key, the fourth upper labial is in contact with the supraocular behind the eye, the post ocular being absent. The length of the snout from the eye is equal to three or more times the diameter of the eye. The nostril suture invariably connects with the prefrontal, and is never isolated. as in *A. pulchella.*

Localities.—Ten specimens were examined from the following localities :—Bumbleyung, Fremantle, Cottesloe, and Midland Junction, all in Western Australia.

Acknowledgments.

I wish to thank Mr. H. A. Longman, Queensland Museum for the loan of De Vis' types and for helpful advice, Mr. Edgar R. Waite, South Australian Museum, for the loan of rare species, Mr. L. Glauert, Western Australian Museum for sending me the entire collection of legless lizards, including types ; Mr. J. A. Kershaw, National Museum, Melbourne, for the loan of the type of the unique *Ophidiocephalus taeniatus* ; the Committee and the Curator, Mr. J. Shewan, of the Macleay Museum, Sydney University for the loan of the entire collection of legless lizards in that Institution ; and Mr. C. Lord, Tasmania, for information relating to the Pygopodidae in that State. I am also indebted to the Director, Dr. C. Anderson, for his help in translating various notes and descriptions.

NOTE ON *PSEUDELAPS MINUTUS* FRY.

By

J. R. Kinghorn, C.M.Z.S.

Pseudelaps minutus *Fry*.

Pseudelaps minutus Fry, Proc. Roy. Soc. Queensland, xxvii, 4, 1915, pp. 93-94, fig. 7.

This species is identical with *Denisonia coronoides* Gunther. I have examined Fry's type and co-types and find that the main characters are as follows :—Fang followed by three to four maxillary teeth. Subcaudals in a single row. Anal entire. Pupil round.

These, without doubt, place Fry's species in the genus *Denisonia*, while an examination of the specific characters shows that they agree with those of *D. coronoides* as described by Boulenger.[1]

I have examined a series of specimens belonging to this species in the Australian Museum collection, ranging from 116 to 520 mm. in length, and find that the characters do not vary beyond the ordinary specific limits. The ventrals range from 148 to 157, and the subcaudals from 44 to 59. The temporals are usually 2×2, but an occasional abnormal specimen will show 2×2 on one side of the head and 2×3 on the other.

As far as the colour markings are concerned, I find that the yellow nuchal collar may be present or absent, as also may be the light line through the upper labials. The black line from the snout to the temporal region may be either very distinct, or broken up and indefinite. The general colour above is brown, while the scales may be uniform, or striated, and the tips darker than the bases.

The top of the head is generally much darker than the body, and more or less mottled, while the snout is not so dark and profusely speckled with dark brown. The ventrals may be uniform yellowish, or there may be a few speckles, and dark edges to the scales. The chin and throat is almost invariably dark and mottled.

It is worthy of note that both *Pseudelaps christeanus* and *minutus* were misplaced under *Pseudechis* by C. Tate Regan,[2] a slip which, if not corrected, might lead to considerable confusion among authors.

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[1]Boulenger—Brit. Mus. Cat. Snakes, iii, 1896, p. 336.
[2]C. Tate Regan—Zoological Record, lii, 1915, Reptiles, p. 15.

THE "TICRACO CREEK" SIDERITE.

By

T. Hodge Smith, Mineralogist and Petrologist, Australian Museum, and H. P. White, Chief Analyst and Assayer, Department of Mines.

(Plates ii-iv, and Figure 1.)

While Mr. J. F. Connelly was prospecting in the vicinity of Mount Padbury, Western Australia, on the North Murchison Gold Field, during August 1922, he learnt from a small party of miners that a meteorite had been found and had been taken to town. After a number of inquiries as to its whereabouts he finally traced it to a rubbish tip at Meekatharra. It had been dumped here by the original finders, who had discovered it near the head of Ticraco Creek, North Murchison Gold Field (Lat. 26° 20′ South, Long. 118° 20′ East), at a height of 2,000 feet above sea level, on the surface of the ground. Neither the name of the discoverer nor the date of finding is known.

The weight of the meteorite is 4173.5 grams and the specific gravity of the whole, including the weathered crust, is 7.59. These determinations were made by Mr. A. J. Christie, Superintendent, Royal Mint, Sydney Branch.

The meteorite, apparently, had remained partially buried for some considerable time, as half had been more or less protected from the action of weathering while the other half had a thick coating of iron oxide. Naturally etched Widmanstätten figures are very conspicuous, and in one place some of the plates of nickel-iron alloys have been removed by weathering, showing the internal structure in relief. (Plate iv, fig. 3). "Thumb-marks" are well developed; two of these depressions on opposite sides meet to form a hole practically through the centre. In addition to the thumb-marks the whole surface is pitted, while there are a number of "drill-holes" measuring from 20 to 30 mm. in diameter with a maximum depth of 50 mm. At one end of the meteorite one of these drill-holes has completely pierced it. (Plate iv, fig. 1).

Though the usual theory in regard to "thumb-marks," is that they have formed during the passage of the meteorite through the atmosphere, may be true, it does not seem to account for the origin of the "drill-holes." It is therefore suggested that these have been formed, after the meteorite has come to rest, by the action of weathering on such a mineral as troilite.

The polished surface of the cut meteorite (Plate ii) was etched with very dilute nitric acid. In the etching two interesting features were noted. Firstly one end was more easily etched than the other, and, secondly, the Widmanstätten figures were more closely spaced in this portion. This is possibly due to a slight variation in chemical com-

position. N. T. Belaiew[1] states that a very high temperature of the mass below the temperature of fusion results in large granulation and then a relatively rapid cooling, which results in a quick separation of kamacite and taenite. There is no reason to believe that different temperatures affected the two ends of this meteorite, nor that the rate of cooling was different, and thus these two factors could not be responsible for the variation in etching.

The etched surface shows a considerable amount of included minerals of which troilite and schreibersite have been determined. One of the nodules (Plate iv, fig. 2) has what appears to be a crystal of schreibersite penetrating the troilite, which is again partially surrounded by schreibersite.

One hundred measurements of the thickness of the plates gave an average of 4.08 mm., so that the siderite belongs to the fine octahedrite (*of*) of Brezina's classification.

Slices of the meteorite for analysis were cut with an ordinary engineer's hacksaw. It was noticed that when the meteorite was cold cutting was more difficult than when warm, indicating that the hardness decreases with an increase of temperature.

The analysis was made by one of the writers (H.P.W.) with the following result :—

Iron	89.056
Nickel	9.660
Cobalt	0.720
Copper	trace (less than 0.0005)
Chromium	trace (less than 0.0005)
Phosphorus	0.203
Sulphur	0.143
Chlorine	absent
Carbon	0.008
Silicon	absent
Platinum	0.001
	99.791

The following elements were looked for but not found :—antimony, tin, manganese, titanium, tungsten, vanadium, uranium, molybdenum, gold, zinc, calcium, magnesium. A minute trace of some platinum metal, insoluble in aqua regia, is present, probably iridium or osmiridium.

From the above analysis, assuming the composition of troilite as FeS and schreibersite as Fe_2NiS, the mineral content will be as follows :—

Metallic alloys.—		
Iron	88.171	
Nickel	9.330	
Cobalt	0.720	98.221
Troilite		0.352
Schreibersite		1.208
Platinum		0.001
Carbon		0.008
		99.790

[1]Belaiew—On the genesis of Widmanstätten structure in Meteorites and in iron-nickel and iron-carbon alloys. *Min. Mag.*, XX, 1904, pp. 173-185.

The iron-nickel ratio is 9.4 which brings the meteorite into group 2, class iron of Prior's classification.

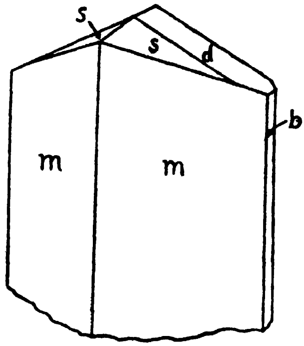

Fig. 1. Schreibersite from the "Ticraco Creek" siderite.
Forms—b(013), m(110), d(101), and s(177).

The meteorite dissolves readily in dilute acid leaving a residue varying in amount from 0.16 to 2.36 per cent. This residue consists of small flakes and grains, skeleton crystals and diverging groups of prismatic crystals. The largest individual crystal measures 3 mm. in length. The colour varies from steel grey to dark iron-grey, and the lustre is metallic, brilliant. Specific gravity is 7.01. For the most part the faces are more or less rounded and unsuitable for measurement. Other faces, giving good signals but very large indices, are probably accidental impressions or contact planes resulting from pressure of neighbouring crystals or of the nickel-iron alloy. On one crystal (Fig. 1) giving fairly good signals, the following forms previously recorded for rhabdite, the terrestrial form of schreibersite ($c = 0{\cdot}4880$) were recognised:—*b* (010), *m* (110), *d* (101). A new form *s* (177) was represented by two faces giving good signals. The only other pyramid present appeared to be *p*(111) which was very much rounded. Two planes vicinal to this form are present.

The following table gives the φ and ρ angles, measured and calculated:—

Form	Measured				Calculated				Error	
	φ		ρ		φ		ρ		φ	ρ
	°	′	°	′	°	′	°	′	′	′
b(010)	1	06	90	00	0	00	90	00	66	—
m(110)	45	05	90	07	45	00	90	00	05	07
d(101)	89	24	26	03	90	00	26	07	36	04
s(177)	8	07	24	54	8	07	24	32	—	21

MINERALOGICAL NOTES No. 2*

By

T. Hodge Smith, Mineralogist and Petrologist.

(Figures 1-5.)

On the Identity of " Green Rhodonite " with Manganhedenbergite

Dr. F. L. Stillwell[1] has described a mineral from Broken Hill, New South Wales, under the provisional name of " Green Rhodonite." Not having obtained a specimen of this mineral the writer took the opportunity of a generous offer of Mr. A. Fairweather, Manager of the South Mine, Broken Hill, to collect a quantity of this material from section E, 725-ft. level. Later a specimen from The Pinnacles was submitted for determination, which proved to be identical with the material from the main Broken Hill lode. So distinct in general appearance was this material from rhodonite that it seemed that the term " Green Rhodonite " was misleading at least.

Taking the analysis by Mr. F. H. Searcy[2] quoted by Dr. Stillwell, it will be seen from the following table that chemically the mineral is practically identical with manganhedenbergite, from Dognacska.[3]

	1	2	3
SiO_2	48.30	48.38	8
Al_2O_3	3.22	0.68	.5
Fe_2O_3	2.04	3.23	
FeO	17.10	15.88	3.5
MnO	7.10	7.94	
CaO	22.54	22.10	4
MgO	nil	2.22	
Alkalies	......	0.28	
	100.30	100.71	

1. " Green Rhodonite," Broken Hill.
2. Manganhedenbergite, Dognacska.
3. Molecular Ratio from No. 1.

*For No. 1, see " Records," vol. xiv., No. 2, 1923, p. 101.

[1]Andrews—Mem. Geol. Surv. N.S.W., Geol., No. 8, 1922, App. II (Stillwell), pp. 385-386.

[2]Mr. H. P. White, Analyst and Assayer to the Geological Survey of New South Wales, has shown me an analysis made by himself which agrees substantially with that by Searcy.

[3]Dana—System of Mineralogy 6th Ed., 1892, p. 359.

It is at once obvious that the composition of the so-called "Green Rhodonite" from Broken Hill approximates the formula $Ca(Fe,Mn)(SiO_3)_2$, which is that of manganhedenbergite.

Dr. Stillwell compares the mineral chemically with babingtonite, pointing out that the difference lies in the fact that the iron content of babingtonite is half in the ferrous and half in the ferric state. This is a very important difference, as the composition of babingtonite may be represented as $(Ca,Fe,Mn)\ SiO_3$ with $Fe_2(SiO_3)_3$. The ratio of these two molecules as derived from the analysis of the "Green Rhodonite" is 23:1, while the ratio in the babingtonite quoted is only 9:1. The specific gravity of the mineral as determined by Mr. C. M. G. Friend is 3.53, while that given by Dana for the Dognacska manganhedenbergite is 3.55. The specific gravity of babingtonite is 3.35 to 3.37.

A number of cleavage fragments was obtained and two were measured on a two-circle goniometer. The signals obtained were not satisfactory. The following is a table of the results of measurement.

Interfacial Angle	Measured	Calculated	Error.
	° ′	° ′	′
$a(100) \wedge b(010)$	90 13	90 00	13
$a(100) \wedge m(110)$	46 22	46 25	3
$a(100) \wedge c(001)$	75 09	74 10	59

Of these the cleavage faces *c*(001) and *b*(001) are not true cleavages but merely partings, due probably to twinning. Lamellar twinning is shown in thin sections.

From one of the measured fragments sections were cut parallel to *c*(001), *b*(010), and *a*(100) and examined under the microscope.

The section parallel to *c*(001) shows the traces of three cleavages. One cleavage is pinacoidal parallel to *a*(100), while the other two are prismatic parallel to *m*(110). The angle between the traces of the latter two cleavages is approximately 93°. Complete extinction was not obtained, as the section is nearly at right angles to an optic axis. The optical axial plane is at right angles to the pinacoidal cleavage, and is therefore parallel to *b*(010).

The section on *b*(010) shows the traces of the prismatic and pinacoidal cleavages parallel to one another, and a distinct parting parallel to *c*(001). The angle between the two sets of cleavages is approximately 75°. The extinction angle measured in reference to the traces of the prismatic cleavage is 44° 30′.

The section cut parallel to *a*(100) shows the parting parallel to *c*(001) and the traces of the prismatic cleavage. The section is not quite at right angles to an optic axis. The plane of the optical axial angle is at right angles to the trace of the parting parallel to *c*(001), that is parallel to *b*(010).

The mineral is optically positive. The optic axial angle is large and the double refraction strong.

Optically the mineral is identical with a monoclinic pyroxene, with the exception that the measurements of the angle β do not agree with those given for any pyroxene. The angle measured on the goniometer and that measured on the section parallel to $b(010)$ give an angle that is nearly a degree too large. Unfortunately, as the original description of manganhedenbergite[4] is not available to me, I am unable to say whether this variation has been noticed before.

In my opinion the name " Green Rhodonite " should be discarded for manganhedenbergite, with which the mineral is identical.

ALBITE.

UPPER BINGARA, NEW SOUTH WALES.

The Australian Museum collection contains a number of specimens of crystallised albite lining crevices and vesicles of a highly altered rock. These were presented to the Trustees by Mr. D. A. Porter, who first discovered them.

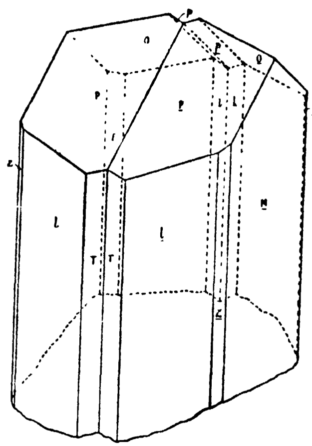

Fig. 1. Albite twinned according to the albite law, from Upper Bingara, New South Wales. (Forms—$P(001)$, $M(010)$, $f(130)$, $T(110)$, $l(1\bar{1}0)$, $z(1\bar{3}0)$, $p(\bar{1}11)$, and $o(\bar{1}\bar{1}1)$.

Prof. W. N. Benson[5] has described albite from this locality, but only as a rock constituent. He states that " in the hand specimens, it appears to be a gabbroid rock that has been highly sheared and veined.

[4]Weibull—Geöl. För. Forh. Stockholm, vi, 1883, p. 505.

[5]Benson—The Geology and Petrology of the Great Serpentine Belt of N.S.W. Pt. iii, Proc. Linn. Soc. N.S.W., xxxviii, 1913, p. 687.

Mineralogically it is altered beyond recognition as a gabbro. It consists chiefly of tremolite . . . set in a ground mass of albite-felspar . . . The rest of the rock is made up of large veins of prehnite." It is apparently this rock in which Porter discovered the albite associated with well crystallised clear quartz. The albite crystals are twinned according to both the albite and pericline laws, the latter being indicated only by striations on $M(010)$. They vary in size up to 3 mm. in length. The habit is fairly constant, crystals being more or less tabular, parallel to b. Generally the colour is milky when the crystals are transparent only on the thin edges, otherwise they are colourless and transparent. The following forms have been recognised—$P(001)$, $M(010)$, $f(130)$, $T(110)$, $l(1\bar{1}0)$, $z(1\bar{3}0)$, $p(\bar{1}11)$ and $o(\bar{1}\bar{1}1)$. A brachydome is present in many crystals, but the faces either produced a series of blurred signals or else no signal at all. The faces were striated due to polysynthetic twinning, and, although bright, in general gave blurred signals. The following table gives the measured and calculated angles :—

Form	Measured		Calculated		Error	
	φ	ρ	φ	ρ	φ	ρ
	° ′	° ′	° ′	° ′	′	′
$P(001)$	81 48	27 22	81 51	27 01	3	21
$M(010)$	0 08	90 00	0 00	90 00	8	
$f(130)$	29 58	90 00	30 23	90 00	25	
$T(110)$	60 05	90 00	60 30	90 00	25	
$l(1\bar{1}0)$	119 22	90 00	119 52	90 00	30	
$z(1\bar{3}0)$	149 26	90 00	149 44	90 00	18	
$p(\bar{1}11)$	36 36	38 41	36 53	38 30	17	11
$o(\bar{1}\bar{1}1)$	134 54	34 13	135 21	34 11	27	2

Only the colourless crystals were chosen for analysis, with the following result :—

SiO_2	66.98		
Al_2O_3	20.07	Or	0.55
CaO	0.80	Ab	95.36
MgO	trace	An	3.89
Na_2O	11.32		
K_2O	0.17		
	99.34		

This places the composition of the felspar as $Ab_{96}An_4$. The extinction on b with reference to the edge b/c is 18° 30′.

With reference to the occurrence of the albite, it is of interest to note that gabbro dykes intruding the Great Serpentine Belt of New South Wales are altered to tremolite-prehnite-albite rocks and to pyroxene-prehnite-grossularite rocks. These dykes have been intruded very shortly

after the injection of the ultra-basic magma, and have been subjected to the metamorphic agencies which have produced the serpentine. They are highly crushed rocks, and like the serpentine are much slickensided. In dealing with the occurrence of grossularite in these rocks at Bowling Alley Point[6] I suggested that the magmatic solutions containing silica and a little carbon dioxide, injected together with the gabbro or very shortly after, were responsible for the production of the grossularite. There is no evidence of alkaline solutions having had any part in the alteration of the dykes here. It might be mentioned that at Bowling Alley Point there is an occurrence of albitised dolerite, which according to Benson is older than the serpentine and intruded by it, but it is impossible to state whether albitisation took place before or during the intrusion of the serpentine with its dykes and intruded masses of gabbro.

Regarding the alteration of these dykes there appear to be three possibilities to be considered, namely : (a) the original gabbro rocks were of different composition ; or (b) the solutions responsible for the alteration of the gabbro were different in composition ; or (c) the grossularite and albite were crystallised by the action of a common solution on similar rocks under different conditions.

(a) If the rock was of different composition from the usual type, which is characterised by the very basic felspar anorthite, and the solutions responsible for the alteration were non-alkaline, as deduced from the evidence at Bowling Alley Point, the felspar of the original rock would be labradorite. The evidence on this point is somewhat slender but is wholly against such a supposition.

(b) The assumption that the magmatic solutions varied in composition would be a very convenient way of explaining the facts. But as the grossularite-bearing dykes occur along the strike of the serpentine belt for many miles, and at Upper Bingara are in fairly close proximity to the albite-bearing dykes, it seems unreasonable to assume a variation in composition of such magnitude.

(c) If it is assumed that magmatic solutions were constant in composition, it is necessary to explain the fact that the alteration product of some of the dykes is albite and of others grossularite. It is at once obvious that the solution acting on the same rock must be capable of producing both minerals. So far as the field evidence goes there appears to be no association of these two minerals. The alteration of all the dykes has been effected by great pressure and the interaction of magmatic solutions either during the intrusion or very shortly after. Both albite and grossularite are high temperature minerals. The evidence of the form of silica deposited in the vesicles and crevices of the dykes is important. Where grossularite has crystallised out, chalcedony is the associated mineral, but where albite has crystallised, the silica is in the form of well crystallised quartz. The only other locality known to me where albite occurs in the serpentine belt is at Wood's Reef, and it is significant that at both these

[6]Smith—Mineralogical Notes No. 1, Rec. Austr. Mus., xiv, 2, 1923, p. 104.

localities the outcrop of the serpentine is notably wider than at any of the localities where grossularite is found.

It is concluded that the solutions responsible for the alteration of the dykes contained soda in addition to silica and a little carbonic acid, but that in general the conditions of recrystallisation were unfavourable to the formation of soda-bearing minerals, and the dykes have been converted into grossularite-bearing rocks. In exceptional circumstances, due to variation of temperature, or pressure, or both, the albite was formed at the expense of grossularite.

AUTUNITE.

MOUNT PAINTER, SOUTH AUSTRALIA.

The Australian Museum collection contains a number of specimens of crystallised autunite from Mount Painter. It occurs as greenish-yellow to canary-yellow crystal aggregates, on an ironstone-quartz matrix. The best descriptions of the field occurrence are given by L. K. Ward.[7]

A number of crystals were selected for measurement, but only one was found to give signals, and they were very much distorted. In every case the faces were etched. The following forms were recognised:—*a*(100), *b*(010), *c*(001), and *d*(101). The crystal measures 2 x 2 mm., measured along the *a* and *c* axes, and is very thin, i.e., it is tabular on the *b*(010) face.

An analysis of crystals freed from impurities was made by Mr. W. A. Greig, senior analyst, Geological Survey of New South Wales, with the following result:—

Analysis		Molecular Ratio	Ratio
	%		
P_2O_5	14.80	.104	1.00
UO_3	58.85	.206	1.98
CaO	6.56	.117	} 1.18
MgO	0.26	.006	
H_2O	19.60	1.089	10.47
	100.07		

Specific Gravity = 3.198.

From the above analysis it will be seen that the formula approximates $CaO.\ 2UO_3.P_2O_5 + 10\frac{1}{2}H_2O$. The formula given by Dana for autunite contains only eight molecules of water, but it is pointed out that analyses show variations up to twelve molecules.

[7] Review Mining Operations South Australia . . . December 31st 1912, No. 17, pp. 27-32; *ibid*, June 30th 1914, No. 20, pp. 36-38.

Molybdenite.

Kingsgate, New South Wales.

The Australian Museum collection contains a crystal of molybdenite from Kingsgate, New South Wales. It is partly enclosed in quartz and is approximately 10 mm. in diameter and 2 mm. thick. Unfortunately it is slightly bent, making accurate measurements impossible. It is interesting to note that the basal plane $c(0001)$ is undoubtedly present. The only other form present is a pyramid, and to determine this form the crystal was mounted on a two-circle goniometer with the vertical circle locked. The edges of a pyramid and the basal plane were adjusted so as to be vertical. As eight faces of the pyramid are present it was necessary to mount the crystal in four different positions. No attempt was made to distinguish positive and negative forms. Three of the faces gave practically a continuous series of signals through a rotation of 90°, and another face yielded two signals which gave an angle with the basal plane of 81° 34′ and 59° 06′. Neglecting the former measurement, the following are the measured angles

	°	′
	55	26
	55	31
	59	06
	56	03
	57	10
Average angle	56	39

Taking $\dot{c} = 1.908$ as assumed by Brown[8], this corresponds fairly closely to $t(20\bar{2}3)$. The calculated angle is 55° 45′.

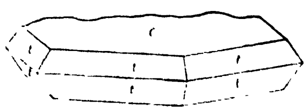

Fig. 2. Molybdenite, Kingsgate, New South Wales. Forms—$c(0001)$ and $t(20\bar{2}3)$.

The pyramids are striated parallel to the edge $c{:}t$, and in a lesser degree parallel to the edge $t{:}t$. Striations on the basal plane are parallel to the edge $c{:}t$.

[8] Brown—Proceedings, Academy of Natural Sciences, Philadelphia, 1896, p. 210.

Zircon.

Anakie, Queensland.

Mr. H. Macnamara presented to the Trustees a crystal of zircon from Sapphire Town, Anakie, Queensland, which has been measured on a two-circle goniometer. It measures 7 mm. x 4 mm. x 3 mm., and belongs to the variety hyacinth, with a specific gravity of 4.69.

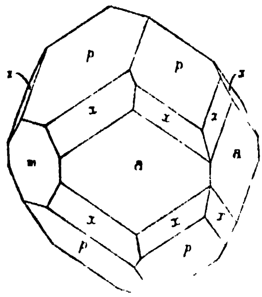

Fig. 3. Zircon from Anakie, Queensland. Forms—*a*(100), *m*(110), *p*(111), and *x*(131).

Zircons in this district occur in alluvial deposits associated with sapphire and pleonaste. Crystals suitable for measurement appear to be somewhat rare.

The following table gives the calculated and measured φ and ϱ angles.

Form	Measured		Calculated		Difference	
	φ	ϱ	φ	ϱ	φ	ϱ
	° ′	° ′	° ′	° ′	′	′
a(100)	0 30	90 01	0 0	90 00	30	01
m(110)	45 01	90 01	45 0	90 00	01	01
p(111)	45 05	42 10	45 0	42 09	05	01
x(131)	18 28	63 44	18 26	63 43	02	01

Rocky River, Uralla, New South Wales.

The Australian Museum collection contains a great number of zircons from this locality. Mr. D. A. Porter[9] has already described the zircons

[9]Porter—Proc. Roy. Soc. N.S.W., xxii, 1888 (1889), p. 84.

from here. He states that they occur in auriferous drift with titanic iron, topaz, and sapphires. He also notes that "the prismatic form, if at all existing must be extremely rare, as not one example was observed in the examination of some thousands of specimens." As a matter of fact quite a number of the crystals in the collection have prism forms present and well developed, though the majority are simple bi-pyramids. In two crystals measured the following forms were identified. *a*(100), *m*(110), and *p* (111).

DIAMOND.

COPETON, NEW SOUTH WALES.

Mr. G. W. Card, A.R.S.M., Curator of the Mining and Geological Museum, Sydney, very kindly lent a twin crystal of diamond from Copeton, New South Wales, for measurement.

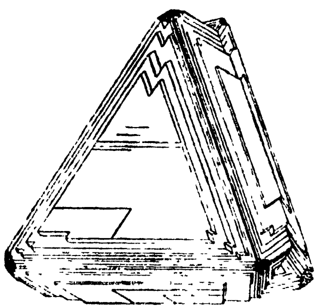

Fig. 4. Diamond twinned according to the spinel law, from Copeton, New South Wales.

The crystal weighs 0.1202 grammes. It is colourless and consists of the octahedron twinned on the octahedral face (spinel law). Both components of the twin are flattened parallel to the twin plane, and are built up of successive plates parallel to this plane. The faces are bright and give excellent signals except those forming the re-entrant angles of the twin.

ANGLESITE.

NORTHERN TERRITORY.

Some crystals were obtained from a specimen of anglesite from Eveleen Mine, 130 miles from Port Darwin, Northern Territory. They range from microscopic size up to 4 mm. x 3 mm. x 3 mm., and occur in two distinct habits. The larger crystals are stout and doubly terminated and the smaller are slender prisms elongated parallel to the *c* axis. The basal plane when present is striated parallel to the edge *d*:*c* ; the remaining faces were all more or less corroded and generally they gave somewhat blurred signals. The following table gives the measured and calculated φ and ρ angles.

Forms	Measured φ	Measured ρ	Calculated φ	Calculated ρ	Difference φ	Difference ρ
	° ′	° ′	° ′	° ′	′	′
c(001)	...	00 00	...	00 00		
m(110)	51 55	89 59	51 51	90 00	04	01
o(011)	06	52 12	00	52 12	06	
d(102)	90 00	39 24	90 00	39 23	-	01
z(111)	51 36	64 44	51 51	64 24	15	20

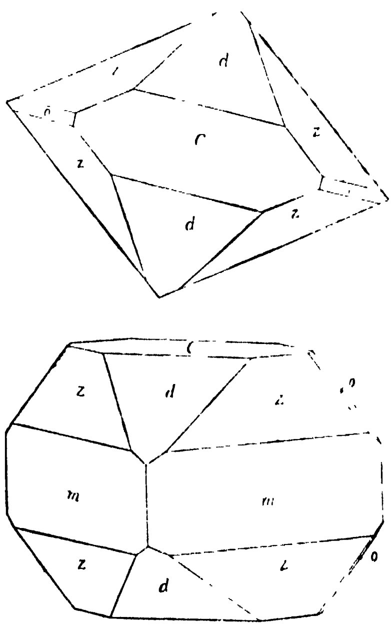

Fig. 5. Orthographic and clinographic projections of anglesite from Eveleen Mine, Northern Territory. . Forms—*c*(001), *m*(110), *o*(011), *d*(102), and *z*(111).

STUDIES ON AUSTRALIAN BRYOZOA.*

No. 3.

By

ARTHUR A. LIVINGSTONE, Assistant in Zoology, Australian Museum.

(Plates v-viii, figure, and map)

REPORT UPON THE BRYOZOA COLLECTED ON THE GREAT BARRIER REEF, QUEENSLAND, in 1925, BY W. E. J. PARADICE, LIEUTENANT SURGEON ON H.M.A.S. "GERANIUM."

INTRODUCTION.

The collection forming the basis of this report was secured on the Great Barrier Reef, Queensland, by Lieutenant Surgeon W. E. J. Paradice, R.A.N., during the survey operations of H.M.A.S. "Geranium." The material is mostly from deep water off various islands, shoals, and reefs mentioned herein. Dredges and rope tangles were used with advantage in certain places, but owing to the coral obstructions much valuable material was undoubtedly missed.

In all twenty-eight species and varieties were taken and this number compares favourably with that secured by previous expeditions to the Great Barrier Reef and north Australia.

Our knowledge of the bryozoa inhabitating the waters of the Torrid Zone is not so far advanced as it is of those forms inhabiting other parts of the globe. This is more apparent when we compare the work done upon the Victorian and New South Wales bryozoa with that on Queensland, Northern Territory, and north west Australian forms. Comparatively speaking our knowledge of tropical species has been compiled only of recent years, earlier papers being few and scattered. Waters[1] has given a helpful list of papers "specially dealing with the tropical forms," and to the number of works on this list the following papers on tropical and subtropical species may well be added, besides numerous papers by Okada and Yanagi in "Annotationes Zoologicae Japonensis" for recent years.—

Waters, A. W., Tubucellaria: its Species and Ovicells. *Journ. Linn. Soc., Zool.*, xxx, 1907, p. 126.

Maplestone, C. M., Polyzoa from the Gilbert Islands. *Proc. Roy. Soc. Vict* (n.s.), xxi, pt. ii, 1908 (1909), p. 410.

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*For No. 1, see "Records," vol. xiv, No. 3, p. 189.

[1]Waters—Journ. Linn. Soc., Zool., xxxi, 1909, pp. 124-5.

Calvet, L., Bryozoa from The Malay Archipelago. *Rev. Suisse Zool.*, xiv, 1909, p. 617.

Waters, A. W., Reports on the Marine Biology of the Sudanese Red Sea, xv., The Bryozoa, pt, ii, Cyclostomata, Ctenostomata, and Endoprocta. *Journ. Linn. Soc., Zool.*, xxxi, 1910, p. 231.

Thornely, Miss L. R., The Marine Polyzoa of the Indian Ocean, from H.M.S. "Sealark." *Trans. Linn. Soc.*, (2), xv, 1912-13, p. 137.

Waters, A. W., The Marine Fauna of British East Africa and Zanzibar (Cheilostomata). *Proc. Zool. Soc.*, 1913, pt. iii, p. 458.

Thornely, Miss L. R., Polyzoa of Okhamandal in *Hornell—Report to the Government of Baroda on the Marine Zoology of Okhamandal in Kattiawar*, pt. ii, 1916, p. 157.

Waters, A. W., Some Collections of the Littoral Marine Fauna of the Cape Verde Islands. *Journ, Linn. Soc., Zool.*, xxxiv, 1918, p. 1. (further references on p. 2).

Marcus, E., The Natural History of Juan Fernandez and Easter Island, iii, Upsala, 1920, p. 93.

Robertson, Miss A., Bryozoa from the Bay of Bengal and other eastern Seas. *Rec. Ind. Museum*, xxii, 1, 1921, p. 33.

Marcus, E., Indo-pacifische Bryozoen aus dem Riksmuseum in Stockholm. *Arkiv for Zool., Stockholm*, xiv, 7, 1921, p. 1.

Marcus, E.,[2] Sudafricanische Bryozoen aus dem Sammlung des Gothenburger Museums, nebst 1, westafricanische species. Gotheborg, 1922 (*fide* O'Donoghue, 1924).

O'Donoghue, Chas. H., Bryozoa Collected by the S.S. " Pickle." *Union of S. Africa Fisheries and Marine Biol. Survey, Rept. No.* 3, 1922 (1924).

Marcus, E.,[2] Bryozoa from Aru Islands. *Abh. Senck. Ges. Frankfurt A.M.*, xxxv., 1923, p. 421 (*fide* Zool. Record, 1923).

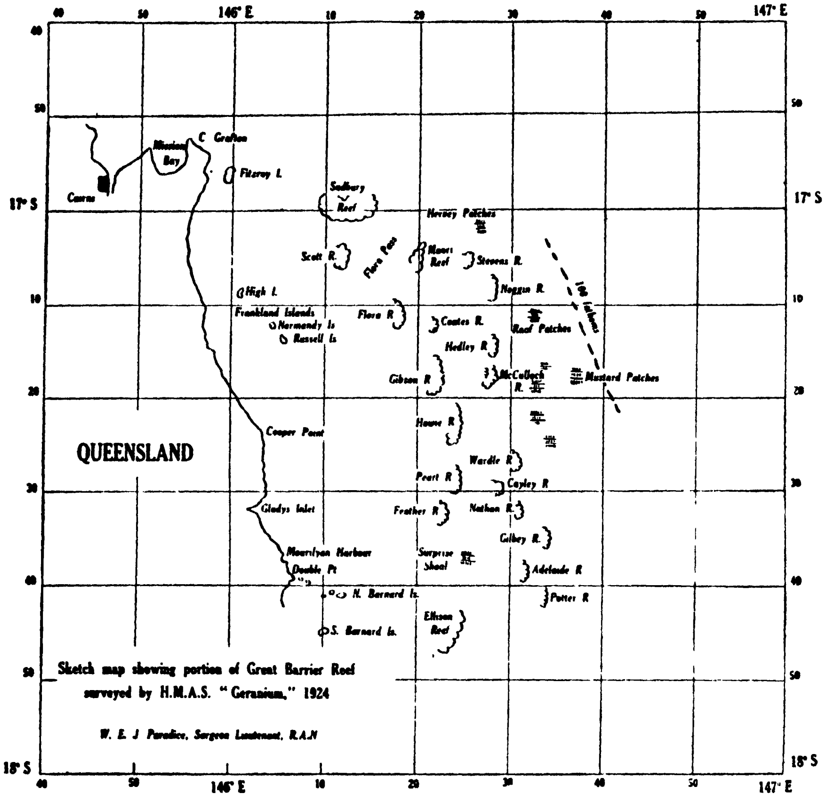
Harmer, S. F., On Cellularine and other Polyzoa. *Journ. Linn. Soc., Zool.*, xxxv, 1923, p. 293.

Many remarkable facts were discovered or confirmed during the examination of the specimens, particularly those relating to the distribution and modification in characters of various species. In reference to distribution the report will show that many Indian and South African species also inhabit the waters of the Great Barrier Reef, a fact that points to a conclusion that the tropical forms represent a more or less comprehensive group.

In many tropicopolitan species the avicularia attain great dimensions ; indeed they are much larger and more formidable than those found on

[2]These papers are not available to me.

species inhabiting the temperate waters of the Australian Continent. One particular type of avicularium has caused much surprise not only to myself but to Mr. Thos. Whitelegge and Rev. Dr. Thos. Porter, both of whom have studied Australian bryozoa for many years. These two



Sketch map showing portion of Great Barrier Reef surveyed by H.M.A.S. "Geranium," 1924

W. E. J Paradice, Surgeon Lieutenant, R.A.N

gentlemen agree with me that an avicularium is formed from a modified operculum on certain zooecia of a specimen of *Lepralia* (*Schizoporella*) *quadlingi* (Haswell). I have relegated this species to the genus *Parmularia* and a full account of it is written in the report under the name *Parmularia quadlingi* (Haswell).

Several forms in the collection agree with described species save for characters mainly pertaining to the avicularia. I have, in such cases, created new varieties which can easily be separated from the typical forms, but one specimen (*Lepralia tuberculata* Phillips, *var. avicularis var. nov.*) may be later elevated to specific rank.

In addition to the material secured by Dr. Paradice in the localities shown on the chart, I have, for the sake of convenience, added at the end of the paper another species to the list, *Petralia chuakensis* Waters, from New Guinea.

Before concluding the introductory notes I must express my gratitude to Dr. Paradice for the trouble he has taken in preparing a chart of the area over which he collected, and for the setting out thereon the relative positions of the reefs and shoals together with their combined relationship to the mainland.

The entire collection has been presented to the Trustees of the Australian Museum.

A list of the species is as follows.—
(?*Membranipora*) *armata* (Haswell).
Selenaria punctata Tenison-Woods.
Steganoporella magnilabris (Busk).
Schizoporella incrassata Hincks.
Schizoporella viridis Thornely *var. thornelyi var. nov.*
Schizoporella unicornis (Johnston).
Schizoporella nivea Busk.
Parmularia quadlingi (Haswell).
Haswellia australiensis (Haswell).
Tubucellaria cereoides var. chuakensis Waters.
Smittina rostriformis (Kirkpatrick).
Smittina trispinosa (Johnston).
Smittina nitida (Verrill).
(?*Phylactella*) *paradicei sp. nov.*
Porella areolata (Kirkpatrick).
Porella fissurata (Ortmann).
(?*Lepralia*) *porcellana* Busk *var. normani var. nov.*
Lepralia tuberculata Phillips *var. avicularis var. nov.*
Lepralia feegeensis Busk.
Lepralia lateralis MacGillivray.
Petralia vultur Hincks.
Petralia vultur Hincks *var. serrata var. nov.*
Petralia vultur Hincks *var. bennetti var. nov.*
Escharoides sauroglossa Levinsen.
Holoporella pigmentaria Waters.
Holoporella aperta (Hincks).
Bipora umbonata (Haswell).
Microporella malusii (Audouin).
Retepora monilifera form umbonata MacGillivray.

ADDITIONAL.

Petralia chuakensis Waters.

(?MEMBRANIPORA) ARMATA *Haswell.*

Biflustra armata Haswell, Proc. Linn. Soc. N.S. Wales, v, 1880, p. 38, pl. I, fig. 7.

?*Membranipora armata* Waters, Proc. Zool. Soc., ii, 1913, p. 486.

Locality.—A solitary specimen dredged in 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

SELENARIA PUNCTATA *Tenison-Woods.*

Selenaria punctata Tenison-Woods, Trans. Roy. Soc. S. Australia, iii, 1879-80 (1880), p. 9, pl. ii, fig. 8a-c.

Selenaria punctata Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 245 (synonymy).

Selenaria punctata Waters. Journ. Linn. Soc., Zool., xxxiv, 1921, p. 416. (and synonymy).

This species is not uncommon off the eastern and north-eastern coasts of the Australian continent, and it is represented in the collection by a single specimen.

It has been my good fortune to have the opportunity of accompanying trawlers operating off various points of the coast of New South Wales, where I have, at times, found the species particularly abundant.

Synonymy.—The type of Haswell's *S. fenestrata,* a species which both Jelly and Waters (*loc. cit.*) place in the synonymy of *S. punctata,* is not in the Australian Museum and cannot be compared to prove the synonymy. It is apparent, however, that Waters has had the necessary specimens to confirm the synonymy first given by Miss Jelly, and it appears that he further adds *S. magnipunctata* Maplestone to the list. This procedure is, in my opinion, perfectly justifiable, for the mere sizes of zoaria are considered negligible so far as specific characters are concerned.

Locality.—Taken from coral reef in 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

STEGANOPORELLA MAGNILABRIS (*Busk*).

Membranipora magnilabris (Busk), Brit. Mus. Cat. Mar. Polyzoa, 1854, p. 62, pl. lxv, fig. 4. (In the explanation of plate called *M. grandis*).

Steganoporella magnilabris Harmer, Quart. Journ. Micr. Sci., xliii, 2, 1900 (n.s),p. 279, pls. xii and xiii, figs. 10, 31, 44-46 (and synonymy).

Locality.—8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

SCHIZOPORELLA INCRASSATA *Hincks.*

Schizoporella incrassata Hincks, Ann. Mag. Nat. Hist. (5), ix, 1882, p. 124, pl. v, figs. 1-1a.

Schizoporella incrassata Thornely, Rept. on the Pearl Oyster Fisheries of Gulf of Manaar, pt. iv, 1905, p. 117.

Only fragmentary colonies of this species were secured in the collection. The specific characters agree well with the description and figures

given by Hincks (*loc. cit.*) and any variations exhibited by the specimens before me have been amply described by Miss Thornely (*loc. cit.*).

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section,"

Great Barrier Reef, Queensland.

8 fathoms Ellison Reef, Great Barrier Reef, Queensland.

SCHIZOPORELLA VIRIDIS *Thornely* var. THORNELYI[3] *var. nov.*

(Pl. viii, figs. 8-9.)

Schizoporella viridis Thornely, Rept. of the Pearl Oyster Fisheries of the Gulf of Manaar, pt. iv, 1905, p. 116, p.l fig. 3 (type).

Schizoporella viridis Waters, Journ. Linn. Soc., Zool., xxxi, 1909, p. 147, pl. 13, figs. 1-8 (type).

Schizoporella viridis Marcus, Arkiv för Zoologi, xiv, 7, 1921, p. 17 (in separate) (type).

Specimens in the collection possess most characters of the species, but differ from the typical form in characters pertaining to the avicularia and the large lateral umbos. These latter structures are considered negligible by Waters (*loc. cit.*) as constant specific characters, but I consider the marked difference in the shape of the avicularia would warrant the creation of a new variety.

Description.—As previously remarked, the general characters are the same as for the typical species, but the variety can be distinguished by the smaller and blunter avicularium on the side of the aperture, and by the large duck-bill-shaped vicarious avicularia as opposed to the long and pointed vicarious avicularia on the typical species. This duck-bill-shaped avicularium on the variety occupies a separate avicularium cell, like the pointed avicularium on the typical species.

Affinities.—The variety approaches *S. ampla* Kirkpatrick[4] in the shape of the avicularia, but differs from that species in the shape of the apertures. Kirkpatrick emphasises the fact that the aperture of *S. ampla* is "characteristic of *Gemellipora*," whereas the aperture of the typical *S. viridis* and the var. *thornelyi* is different and cannot in any way be confused with that of *S. ampla*. Further, the walls of *S. viridis* var. *thornelyi* are rugged and distinctly pitted whereas those of *S. ampla* are described as being "smooth."

The opercula of *S. viridis* (Pl. viii, fig. 10) and the *var thornelyi* have been figured; firstly, to show what little difference exists between them,

[3]Named for Miss L.R. Thornely, the author of the species.

[4]Kirkpatrick—Ann Mag. Nat. Hist. (6), I, 1888, p. 76, pl. 7, fig. 4.

and secondly, to show the difference between the operculum of *S. viridis* as I see it, and as Waters (*loc. cit.*, 1909) sees it. This author's illustration of the operculum seems to coincide with the aperture of *S. ampla* rather than of the species it is associated with.

Locality.—8 fathoms, Ellison Reef, Great Barrier Reef, Queensland. (Figure of operculum of typical form drawn from a specimen collected at Dauco Island, Great Barrier Reef, near Port Moresby, New Guinea, by the late Allan R. McCulloch.)

SCHIZOPORELLA UNICORNIS (*Johnston*).

Lepralia unicornis Johnston, Brit. Zooph., 2nd edit., 1847, p. 320, pl. lvii, fig. 1.

Schizoporella unicornis Waters, Journ. Linn. Soc., Zool., xxxi, 1909, p. 143, pl. xii, figs. 12, 13 (and synonymy).

Locality.—Encrusting coral between 17° and 19° S. Latitude, Great Barrier Reef, Queensland.

SCHIZOPORELLA NIVEA *Busk.*

Schizoporella nivea Busk, Challenger Rep., Zool., x, pt. xxx, 1884, p. 163, pl. xvii, fig. 1.

Schizoporella nivea Waters, Proc. Zool. Soc., ii, 1913, p. 502, pl. lxx, figs. 1-3, 7-9 ; pl. lxxiii, fig. 16 and text fig. 80.

Specimens of the species before me have assumed the hemescharan form, each having a central axis of stick-like marine growth running through the colony. The older colonies can easily be recognised by their heavy calcification, which renders them a conspicuous white or cream colour.

Localities.—On coral, from 28 fathoms, over Gibson Reef, Great Barrier Reef, Queensland; 28 fathoms over Surprise Shoal, Cairns-Townsville "Section," Great Barrier Reef, Queensland ; 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

PARMULARIA QUADLINGI (*Haswell*).

(Pl. vi, figs. 1-2.)

Lepralia (Schizoporella) quadlingi Haswell, Proc. Linn. Soc. N.S. Wales, v, 1880, p. 39, pl. ii, fig. 2.

No further mention of this peculiar species can be traced since Haswell dredged it in 20 fathoms off Holborn Island, Queensland.

The type specimen is in the Australian Museum collection and is seen to be a fragment of an incomplete colony when compared with the material before me. I have no doubt as to the identification being correct.

The species is obviously a representative of the genus *Parmularia*, to which I have given recognition in a previous paper.[5] Its characters agree in every detail with the description given, and, in addition, it has peculiar avicularia which are entirely unknown in any of the present species of the genus.

These peculiar avicularia each represent an elongated operculum, so that the covering of the zooecial aperture in some zooecia plays the dual role of avicularium mandible and operculum. Such avicularia are not seen on Haswell's type specimen.

Description.—As in other members of the genus the zoarium is composed of two layers of zooecia and is trilobed in shape (see Pl. v, fig. 6). The zooecia are ovate, well defined, and covered by a thin transparent membrane. As in *P. obliqua,* they are arranged in arched rows which extend outwards from a median base to the lateral margins in the adult forms, but their formation is slightly variable in young examples.

The frontal zooecial walls are thick and strong, and, as in the other representatives of the genus are well calcified. The frontal zooecial walls are perforated by a number of small pores which are not unlike those seen in *P. obliqua*. The distal and proximal zooecial walls are roughly " S " shaped, and the lateral zooecial walls are, as in the other species, nearly straight.

The zooecial apertures are sunk below the level of the surrounding frontal walls, are elliptical in shape and in each of their proximal borders is a well defined sinus. Extending inwards from the proximal border of the aperture is a calcareous lip which is hollowed out to accommodate the sinus. Zooecial apertures in which the opercula have developed into avicularia, are seen to be somewhat distorted when compared with the normal apertures. They are markedly elongate, though they have, like the normal apertures, a sinus in each of their proximal borders. The aperture is divided into two chambers ; the proximal one leads to the interior of the zooecium and through it the animal communicates with the exterior. The other chamber is situated distally and is merely shallow and cup-like ; it has no visible means of communication with the interior of the colony and its only entrance, or means or communication with the exterior, is by means of the common aperture.

The ooecium is, as in *P. obliqua*, large and dome-shaped, and possesses dividing sutures or furrows which are of the same nature as those dividing the zooecia. The opening of the ooecium is covered by the operculum of the zooecial aperture. Running around the distal border of the ooecial aperture is a continuation of the lip seen in the proximal borders of some of the zooecial apertures. The ooecium is punctured in the same manner as the frontal zooecial walls and the pores are covered by a thin transparent membrane. The normal operculum is weakly chitinised and fits the aperture and the sinus perfectly. In some zooecia the operculum is elongated to form an avicularium and, like the normal operculum, is weakly

[5] Livingstone—Rec. Austr. Mus., xiv, 3, 1924, p. 189.

chitinised. It is supported by two sclerites which extend almost the whole length of the avicularium. These sclerites join in a blunt point distally, and again unite proximally to form a rounded proximal border to the whole structure (see Pl. vi, fig. 1).

Colour.—The colonies are white when dried.

Mode of attachment.—The colony is attached, apparently to the sea floor or some object thereon, by means of a long, delicate, and semi-transparent filament, which is inserted into an elongated concavity on the base of the colony. This method is adopted by all the known species of the genus.

Variation.—In young specimens the zooecia are somewhat irregularly spaced, but on the whole, they adhere to the true *Parmularia* principle of forming arched rows running from a median basal point. Their structure in general is barely altered by their immaturity save for the shape of the zoarium. Juvenile specimens are entirely destitute of avicularia and ooecia, and it would appear that these latter structures occur only on some zooecia of larger and more mature colonies.

Locality.—28 fathoms over Gibson Reef, Great Barrier Reef, Queensland.

HASWELLIA AUSTRALIENSIS (*Haswell*).

Myriozoum australiense Haswell, Proc. Linn. Soc. N.S. Wales, v, 1, 1880, p. 43, pl. iii, figs. 9-11.

Haswellia australiensis Waters, Proc. Zool. Soc., ii, 1913, p. 511 (and synonymy).

Localities.—28 fathoms over Gibson Reef; between 17° and 19° S. lat. Great Barrier Reef, Queensland.

TUBUCELLARIA CEREOIDES var. CHUAKENSIS *Waters*.

Tubucellaria cereoides var. *chuakensis* Waters, Journ. Linn. Soc., Zool., xxx, 1907, p. 130, pl. xv, figs. 10, 13, 18-19; pl. xvi, figs. 20-25. *Id.*, Proc. Zool. Soc., ii, 1913, p. 512 (and synonymy).

The variety is represented in the collection by a complete and branching tree-like colony 45 mm. high and about the same breadth.

Locality.—Feather Reef, Great Barrier Reef, Queensland.

SMITTINA ROSTRIFORMIS (*Kirkpatrick*)

Smittia rostriformis Kirkpatrick, Ann. Mag. Nat. Hist. (6), 1, 1888, p. 80, pl. viii, fig. 7. *Id.*, Ann. Mag. Nat. Hist. (6), v, 1890, p. 21.

Smittia rostriformis Thornely, Rept. Pearl Oyster Fisheries of Gulf of Manaar, pt. iv, 1905, p. 123.

The species varies to some extent from the descriptions and figures given by Kirkpatrick (*loc. cit.*) and, although the specimens in the collection possess the same shaped avicularia, they may be placed in various positions other than those figured. The avicularium shown above the aperture in the figure of the species may be anywhere around the apertures of the zooecia on a single colony. The two lateral avicularia are fairly constant in position though there may be at times only one present on one zooecium. It is situated far up towards the aperture, and in some cases alongside the aperture, and pointing in a lateral direction. The avicularian cavities are described and figured as serrate, but I have not found this character. The peristome is figured as being well developed, vertical, and deficient in front. I find that these characters apply well to the peristomes on some zooecia whilst in others a deficiency occurs distally as well as proximally.

Spines and ooecia are absent on specimens in the collection.

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section," Great Barrier Reef, Queensland.

SMITTINA TRISPINOSA (*Johnston*).

Discopora trispinosa Johnston, Ed. Phil. Journ., xiii, p. 322.
Smittia trispinosa Hincks, British Mar. Poly., 1880, p. 353, pl. lxix, figs. 1-8.

Colonies of this widely distributed species were found encrusting fronds of coral. The specimens are true to type save for the peristomes, which are produced more in front than is shown in Hincks' (*loc. cit.*) figures.

Locality.—Encrusting coral from 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

SMITTINA NITIDA (*Verrill*).

Discopora nitida Verrill, Amer. Journ. Sci., ix, 1875, p. 415, pl. 7., fig. 3.

Smittia nitida Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 249-50 (and synonymy).

Smittia nitida Waters, Journ. Linn. Soc., Zool., xxxi, 1909, p. 173, pl. xvii, figs. 19-20.

Only fragmentary specimens of this species were secured.

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section"; East of Great Palm Island, 6 fathoms, Great Barrier Reef, Queensland.

(?PHYLACTELLA) PARADICEI[6] *sp. nov.*

(Pl. vii and figure 1.)

Description.—The zoarium is encrusting, and owing to the high produced peristomes appears to the unaided eye to be very prickly. The zooecia are ovate in front though somewhat irregular in shape. The frontal walls are dotted with numerous large granules, and at their edges are punctured with large conspicuous pores.

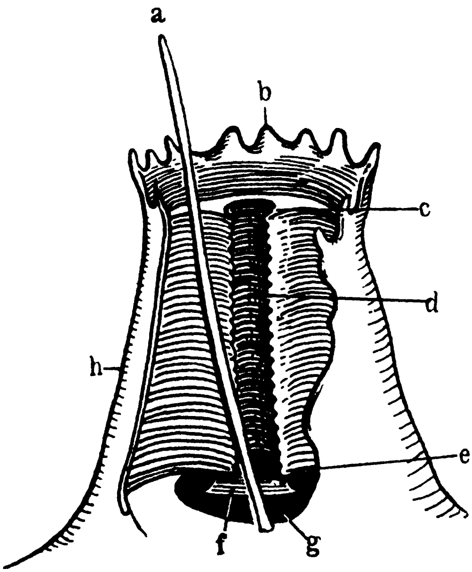


FIG. 1.

Diagrammatic view of the peristome and associated structures of (? *Phylactella*) *paradicei* sp. nov. looking through the distal peristomial deficiency from behind.

(*a*) the solitary hollow spine situated distally to the zooecial aperture and continuing upwards through, and parallel with the deficiency in the peristome.
(*b*) serrated border of the peristomial aperture.
(*c*) one end of the peristomial canal.
(*d*) peristomial canal.
(*e*) lower end of the peristomial canal which ends as a sinus in the zooecial aperture.
(*f*) denticle, occurring as a downwardly projecting continuation of the under-surface of the frontal zooecial wall; is situated directly beneath the sinus in the zooecial aperture.
(*g*) zooecial aperture.
(*h*) lateral peristomial wall.

The avicularia are of two kinds. One type appears as a duck-billed-shape or spatulate avicularium, depressed in the middle or on the edges of the frontal zooecial wall. It is very long and in some cases reaches from the base of the peristome to the proximal edge of the frontal zooecial wall. It invariably faces proximally or laterally and always opens away from the direction of the zooecial aperture. A central cross-bar

[6]Named for Surg. Lieut. W. E. J. Paradice, R.A.N., of H.M.A.S. "Geranium."

is seen in a hollow at one end but a ligula is absent. A small pore is generally present just below the hollow and its central cross-bar. The mandible of this spatulate avicularium is remarkable for its poorly chitinised nature; if allowed to dry it will shrivel up and become considerably distorted. The other type of avicularium is always seen on an eminence about half-way up on one side of the peristome. The avicularian cavity is complete and deep; the mandible is moderately chitinised and does not lose its shape and size when dried as does the duck-bill-shaped mandible described above.

The peristome is remarkable for its characters which are illustrated in the accompanying figure. A single spine arises from the distal edge of the zooecial aperture and continues upwards through and parallel with a distal deficiency in the peristome. The peristomial aperture is round and its border is roughly serrated. Within the peristome is a tooth-edged canal which runs from near the top of the peristome down the zooecial aperture where it ends as a sinus in the proximal border of the zooecial aperture. The same structure can also be explained as being a continuation of the sinus as a serrate edged canal ending near the top of the peristome. The zooecial aperture is semi-ovate distally, and hollowed proximally, with a sinus (continued as a canal into the peristome) in its proximal border. A single denticle occurs just below the sinus as a downwardly projecting continuation of the frontal zooecial wall on the inside. It is sharply pointed at the angles of the free extremity, and in some cases is about half as large as the zooecial aperture.

The ooecia which appear to be characteristic of the genus, are situated distally to the zooecial aperture, and communicate with the exterior by a small opening into the peristomial deficiency. They are not very conspicuous but can be recognised as globose structures punctured with small pores. At their junction with the frontal walls of distal zooecia there is an inconspicuous furrow. When the top of an ooecium is removed two ridges are seen on the basal wall running from the proximal to the distal end as shown in Pl. vii, fig. 1. Described and figured from an incinerated colony.

Colour.—The colony is of a dull yellow hue in its dried condition.

Affinities.—A species that may be confused with this form is *Smittia tropica* Waters[7] but the following characters may be used to differentiate the two species.

(*? Phylactella*) *paradicei* has only one solitary spine above the zooecial aperture, *Smittia tropica* has two. In the former species the frontal walls of the zooecia generally end distally in tall peristomes, while in the latter species the frontal zooecial walls end distally in rounded corners, the peristomes arising separately. Within the peristome of *S. tropica* are two internal ridges apparently not serrate, while in (*? P.*) *paradicei* these two ridges form a canal with serrate edges. No external indications of ridges or a canal are seen on the outside of the peristome of (*? P.*) *para-*

[7] Waters—Journ. Linn. Soc., Zool., xxxi, 1909, p. 174, pl. xvii, figs. 10-14.

dicei, but in *S. tropica* prominent bulges or corrugations serve as external signs of internal ridges.

Locality.—Encrusting a coral in 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

PORELLA AREOLATA (*Kirkpatrick*).

(Pl. viii, figs. 2-4).

Lepralia occulosa var. *areolata* Kirkpatrick, Sci. Proc. Roy. Dublin Soc., vi, 10, p. 618, pl. xvi, fig. 7.

The species before me is undoubtedly the form described by Kirkpatrick as a new variety of *L. occulosa.* No mention of avicularia occurs in this author's description, though he figures one set in the proximal border of the zooecial aperture.

Description.—Zoarium bilaminate, forming encrusting masses or assuming a free-branching condition. The zooecia, which are distinctly separated by raised margins, are ovate and somewhat diamond-shaped. The zooecia are heavily calcified and covered by a thin membrane. The middle of the frontal zooecial wall is slightly elevated above the surrounding areas. In some zooecia the frontal walls are punctured with small pores, while in others areolae run from the edges of the frontal walls to the central umbonate areas.

The aperture is slightly elliptical distally but proximally is rounded off abruptly. It is sunk below the level of the surrounding frontal walls and bounded by a well developed peristome. Within the proximal border of the peristome, and a little to one side, is a small avicularium with a semi-circular mandible.

In some zooecia this avicularium attains comparatively great dimensions, and when in this condition is always found on a mucronate projection immediately below the zooecial aperture. Besides the avicularium in the peristome there is another type occurring on the frontal walls. It is of considerable size and occupies, as in *Lepralia occulosa*, a separate avicularian chamber between the zooecia. The mandibles of these avicularia are duck-bill-shaped. The operculum is well chitinised and is the same shape as the zooecial aperture.

The ooecia are inconspicuous as regards their size, but can be readily recognised by the " calcareous reticulum " as Kirkpatrick (*loc. cit.*) describes it. At first, the ooecium is like a shallow cup on the frontal wall of the zooecium situated distally to the ooecium-bearing zooecium. The sides grow until they have met distally, but proximally a fissure occurs covered by a thin membrane. This membrane is the foundation of the spider's-web-like structure that later comes to occupy the area. The frontal part of the ooecium now bears a marked resemblance to the frontal walls of *Hiantopora ferox*.

Colour.—The colony is white in a dried condition.

Variation.—The species does not vary to any great extent, and on the whole adheres to the principal characters.

Affinities.—Nothwithstanding its close proximity to *Lepralia occulosa* it appears to me to be a distinct species of the genus *Porella*. Consequently I have elevated it to a specific rank and placed it in what I consider a more appropriate resting place.

Locality.—Among coral at High Island, Great Barrier Reef, Queensland.

PORELLA FISSURATA *Ortmann*.

(Pl. viii, figs. 5-7.)

Porella fissurata Ortmann, Archiv für Naturg., lvi, i, 1890, p. 41, pl. iii, fig. 14.

It is with much hesitation that I separate the above species from *P. areolata* but in the absence of sufficient material my investigations must end here. Their structure is almost identical, yet I provisionally distinguish *Porella fissurata* from *P. areolata* on the following characters wnich may, in the future, be found useless. In *fissurata* the avicularium within the peristome is generally a little larger than that seen in *areolata*, but in this latter species large avicularia are sometimes met with. The small round avicularia on the frontal walls of *fissurata* are more numerous than on *areolata*. Both species have special avicularia which occupy separate cells or chambers. The mandibles of these avicularia are duck-bill-shaped, but the ones found on *fissurata* are smaller than those seen on *areolata*. In *fissurata* the ooecia are not areolated in front as in *areolata* and have only a narrow fissure. The figured operculum of *P. fissurata* does not appear to be so elliptical as that of *areolata*.

Locality. — 28 fathoms over Surprise Shoal, Cairns - Townsville "Section," Great Barrier Reef, Queensland.

(?LEPRALIA) PORCELLANA *Busk* var. NORMANI *var. nov.*

(Pl. viii, fig. 1.)

Lepralia porcellana Busk, Quart. Journ. Micro. Sci., viii, 1860, p. 283, pl. xxxi, fig. 3 (type).

Lepralia porcellana Norman, Journ. Linn. Soc., Zool., xxx, 1909, p. 305, pl. xl, figs. 1-2 (type).

For the release of the type species from obscurity we are indebted to Canon A. M. Norman. This author has identified the species with *L. cleidostoma* Smitt, using Busk's original specimen. As a result of his

examination he has placed the latter species in the synonymy of the former. Waters, however, in his paper on the Zanzibar collections[8] does not follow Norman, and states that " as it has been impossible to recognise it [Busk's *L. porcellana*] from Busk's figures the name *cleidostoma* must stand."

The specimen before me is typical of Busk's description and Norman's figure save for the avicularia. On the present specimen these appendages are much longer and broader at the base than those figured by Norman. Indeed they are more like those figures by Miss Thornely[9] for *Gemellepora protrusa*.

On young zooecia one to three spines are seen above the zooecial aperture, but these are very delicate and no doubt this fact is responsible for their scarcity on the specimens in the collection.

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section," Great Barrier Reef, Queensland.

LEPRALIA TUBERCULATA *Phillips* var. AVICULARIS *var. nov.*

(Pl. v, figs. 1-3.)

Lepralia tuberculata Phillips, Willey's Zool. Results, pt. iv, 1900, p. 446, pl. xliii, fig. 8 (type).

Description.—Zoarium encrusting. Zooecia white and shiny. The frontal zooecial walls are coarsely granular, and punctured at their lateral borders by rows of pores. Occasionally the middle of the frontal walls are punctured as well. Aperture coarctate as in the typical form. On the distal border of the aperture there are 5-7 strong well developed spines.

In the typical form there is, on each side of the zooecium, an avicularium, the mandibles of which are blunt and spatulate. The figures of the typical species show them to be either pointed or slightly duck-bill-shaped. In the new variety these avicularia are present, but they differ from those figured for the typical form in being spoon-shaped. Commencing at the fixed end of the avicularian mandible one sees that they are thin, tapering slightly towards the free extremity, where they widen out suddenly and assume a spoon shape.

In the typical form there are, I presume, " numerous large vicarious avicularia with duck-bill-shaped mandibles " on the surface of the zooecia but the author does not seem to make their whereabouts quite clear. In the present variety small avicularia occur on eminences on the zooecia, but their mandibles are roughly triangular and not duck-bill-shaped.

[8] Waters—Proc. Zool. Soc., ii, 1913, p. 517.

[9] Thornely—Rept. on the Pearl Oyster Fisheries of Gulf of Manaar, pt. iv, 1905 p. 119.

Locality. — 28 fathoms over Surprise Shoal, Cairns - Townsville "Section," Great Barrier Reef, Queensland.

LEPRALIA FEEGEENSIS *Busk.*

Lepralia feegeensis Busk, Chall. Rep. Zool., x, 1884, pt. xxx, p. 144, pl. xxii, fig. 9.

Lepralia feegeensis Waters, Proc. Zool. Soc., ii, 1913, p. 514, pl. lxx, figs. 21-22 (and synonymy).

Lepralia feegeensis is a well known tropical species and is found in fair considerable abundance on the N. Queensland coast. Specimens in the present collection are typical of those secured elsewhere.

Synonymy.—Although Levinsen[10] erected the genus *Hippopodina* for the reception of this species I agree with Waters, for the present anyway, in dropping the proposed genus and retaining *Lepralia* as its rightful genus. Sudden changes such as Levinsen proposes may or may not be acceptable, according to the species concerned, and for this reason I hesitate to use the new name until further proof of its soundness is put forward.

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section," Great Barrier Reef, Queensland.

LEPRALIA LATERALIS *MacGillivray.*

Lepralia lateralis MacGillivray, Proc. Roy. Soc. Vict., iii, (n.s.), 1891, p. 80, pl. x, fig. 3.

?*Lepralia calyciformis* Phillips, in Willey's Zool. Results, pt. iv, 1900, p. 446, pl. xliii, figs. 9-9a.

A co-type of the above species has recently been presented to the Australian Museum by the original collector, Mr. W. H. Wooster. It is only a minute fragment, yet sufficient to determine satisfactorily a specimen of the species in the Paradice collection.

The only variation is that the avicularia are more numerous and scattered at random over the surface of the zooecial walls, than in the co-type or as described by MacGillivray.

This species appears to be closely allied to, if not identical with, *L. calyciformis* Philipps (*loc. cit.*)

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section," Great Barrier Reef, Queensland.

[10] Levinsen—Morph. Sys. Stud: Cheil, Bry., 1909, p. 353, pl. xxiv, figs. 3a-b.

PETRALIA VULTUR (*Hincks*).

Mucronella vultur Hincks, Ann. Mag. Nat. Hist. (5), x, 1882, p. 98, pl. viii, fig. 2.

Although there are no representatives of the typical form in the collection, two varieties can be distinguished, one of which may be identical with that secured in the collection from the Gulf of Manaar and described by Miss Thornely under the heading of the typical form. The other new form is described as a variety (*bennetti*) in the following pages.

Judging from Miss A. Robertson's remarks on this species it would appear that there are several more varieties to be described, but, owing to the unfortunate decease of this author, they will, no doubt, be left undescribed for some time.

PETRALIA VULTUR (*Hincks*) var. SERRATA *var. nov.*

(Pl. vi, figs. 7-10.)

?*Mucronella vultur* Thornely (non Hincks), Rept. Pearl Oyster Fisheries of Gulf of Manaar, pt. iv, 1905, p. 124-5.

The species described by Miss Thornely as *M. vultur* Hincks seems to be represented in the present collection by several unilaminate colonies. Many of the characteristic departures from the typical form set out by Miss Thornely are seen in the specimens before me and are of such a nature as to warrant the creation of a new variety.

Description.—General characters as for the typical form, but the variety can be recognised by its massive appearance, the short and broad zooecia, and the duck-bill-shaped mandible on the avicularium situated on the side of the mucro. The mandible of this avicularium is very broad, contracted slightly at its middle, then widens out and becomes rounded at its free extremity. The edges of the mandibles are, as Waters[11] says, serrate especially at their free extremities. Besides avicularia on the mucros, there are avicularia upon the frontal zooecial walls which are elongate, tapering slightly towards their free extremities where they widen and end as round blunt points. They are much longer than those seen on var. *armata*, Waters (*loc. cit.*) 1913, judging from the figures of this latter. Two smaller avicularia occur on each zooecium and are generally seen in the vicinity of the aperture, usually one on each side. They are, however, very minute. Spines above the aperture vary from 5-8 in number.

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section"; Great Barrier Reef, Queensland.

[11]Waters—Proc. Zool. Soc., ii, 1913, p. 519.

PETRALIA VULTUR (*Hincks*) var. BENNETTI[12] *var. nov.*

(Pl.vi., figs. 3–6.)

Description.—The zoarium is very large; encrusting. Zooecia huge and conspicuous. They are roundedly hexagonal in shape and markedly ovate in front. The characters pertaining to the zooecial aperture are the same as for the typical species, but instead of six spines above the aperture there are 7-9 (generally 8) well developed spines above the aperture of the variety. The frontal zooecial walls are, as in the typical form, punctured with pores, but those on the variety are larger than the ones seen on the typical species. Mucro poorly developed and only about half the size of that of the typical form. On the side of the mucro there is a small avicularium, the mandible of which is almost semi-circular. This mandible is not so elongate as, and is less than half the size of the avicularian mandible on the mucro of var. *serrata*. Another form of avicularium occurs on the frontal zooecial walls of many zooecia and is very large and formidable. The mandible is long, tapering towards the free extremity, where it ends in a sharp point. The avicularian cavity is as long as the mandible; it is slightly curved downwards and the cavity is deep. The edges of this avicularian cavity are conspicuously serrate.

Affinities.—The variety is distinct and cannot be confused with any other known variety of the typical species. The possession of 7-9 spines above the zooecial aperture, together with the large avicularia and its serrate-edged cavity alone suffice as means of recognition.

Colour.—The colour of dried colonies is dull cream.

Locality.—Encrusting coral, 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

ESCHAROIDES SAUROGLOSSA *Levinsen.*

Escharoides sauroglossa Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 319, pl. xvii, figs. 6a-f, in text (5a-f in explanation of plates).

A small single fragment in the collection is typical of the form described by Levinsen. The only exceptional features to be noted are that there may be five spines present above the aperture instead of four and that the edges of the avicularian cavities are toothed or serrate as opposed to the smooth edges figured by Levinsen.

Affinities.—The species is allied to *Smittia adeonelloides* Ortmann, which is figured as having sharply pointed avicularia, but can be recognised and separated from this form by the possession of rounded avicularia.

Locality.—8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

[12]Named for Commander H. T. Bennett, R.A.N., D.S.O., H.M.A.S. "Geranium."

HOLOPORELLA PIGMENTARIA *Waters.*

Holoporella pigmentaria Waters, Journ. Linn. Soc., Zool., xxxi, 1909, p. 163, pl. xv, figs. 16-19 ; pl. xvi, figs. 9-16 ; pl. xvii, figs. 22-23.

The dull dark sepia colour of the dried colonies assists greatly in distinguishing the species.

Locality.—Encrusting coral from 8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

HOLOPORELLA APERTA (*Hincks*).

Schizoporella aperta Hincks, Ann. Mag. Nat. Hist. (5), ix, 1882, p. 126, pl. v, fig. 3.

Schizmopora cucullata Maplestone, Proc. Roy. Soc. Vict., (n.s.), xvii, pt. ii, 1905, p. 389, pl. xxix, figs. 7-8.

Schizoporella aperta Thornely, Rept. Pearl Oyster Fisheries Gulf of Manaar, pt. iv, 1905, p. 114.

Holoporella aperta Waters, Journ. Linn. Soc., Zool., xxxi, 1909, p. 161. pl. xviii, figs. 20-23 (and synonmy).

Holoporella aperta Waters, Proc. Zool. Soc., ii, pt. iii, 1913, p. 522.

Holoporella aperta Robertson, Rec. Ind. Mus., xxii, 1, 1921, p. 61.

The specimens before me are similar to those described by Miss Thornely (*loc. cit.*) in having spines above the zooecial apertures.

All other characters of the species are clearly seen and no variation can be determined.

Synonymy.—The species carries, like many other species, a heavy burden of synonymy and I follow Waters (*loc. cit.*) in the synonymy of *H. aperta*. One species however, is queried by Waters as a synonym, namely *Schizmopora cucullata* Maplestone from Lord Howe Island.

The material on which Maplestone based his paper " Lord Howe Island Polyzoa " was entrusted to him by the Rev. Dr. Thos. Porter who collected the specimens at Lord Howe Island. Many unnamed duplicate specimens were afterwards presented to the Australian Museum by Dr. Porter, among which were three well perserved specimens which I identify as *S. cucullata*.

The appearance of this species as a probably synonym of *H. aperta* has caused me to examine these unlabelled co-type specimens of *S. cucullata* and to compare them with the specimens of *H. aperta* from the Barrier Reef, and the description and figure given by Hincks (*loc. cit,*) I find that *S. cucullata* agrees in every detail described by Hincks save for the occurrence of spines above the zooecial aperture ; these however, have been found on *H. aperta* by Miss Thornely and also occur on specimens

from the Barrier Reef. This exception, then, is of no consequence. The description and figure of *S. cucullata* does not embrace all the details of *H. aperta*, but after a comparison of incinerated specimens I confirm the synonymy queried by Waters.

Locality.—8 fathoms, Ellison Reef, Great Barrier Reef, Queensland.

BIPORA UMBONATA (*Haswell*).

(Pl. v, figs. 4-5.)

Eschara umbonata Haswell, Proc. Linn. Soc. N.S. Wales, v, 1880, p. 41, pl. ii, figs. 5-6.

?*Schizoporella quadravicularis* Okada, Annot. Zool. Jap., x, 22, 1923, p. 230, pl. figs. 3-5.

Bipora umbonata Livingstone, Rec. Austr. Mus., xiv, 3, 1924, p. 209 (and synonymy).

This temperate and tropical species is represented in the collection by a single small fragment. It is true to type, there being no variation whatever. *Schizoporella quadravicularis* Okada (*loc. cit.*) appears to be this species and even if it does not prove to be this form it possesses characters which would associate it with *Bipora*.

Locality.—28 fathoms over Gibson Reef, Great Barrier Reef, Queensland.

MICROPORELLA MALUSII (*Audouin*).

Cellepora malusii Audouin, Expl. i, p. 239 ; Savigny, Egypt, pl. 8, fig. 8. (*fide* Hincks, Brit. Mar. Polyzoa, 1880, p. 211).

Lepralia malusii Busk, Brit. Mus. Cat. Mar. Poly., pt. ii, 1854, p. 83, pl. ciii, figs. 1-4.

Microporella malusii Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 186-7 (and synonymy).

This cosmopolitan species is very abundant in Queensland waters generally, and was secured in the collection in the form of delicate leaf-like colonies. It is not heavily calcified like the form found in New South Wales waters, and appears to the unaided eye to be a *Flustra*.

Locality.—7 to 15 fathoms, Ellison Reef, Great Barrier Reef, Queensland,

RETEPORA MONILIFERA form UMBONATA *MacGillivray*.

Retepora monilifera form *umbonata* MacGillivray, McCoy's Prod. Zool. Victoria, dec. x, 1885, p. 23, pl. xcvii, figs. 1-3.

Locality.—28 fathoms over Surprise Shoal, Cairns-Townsville "Section," Great Barrier Reef, Queensland.

Genus Petralia *MacGillivray.*

Petralia chuakensis *Waters.*

Petralia chuakensis Waters, Proc. Zool. Soc., 1913, p. 518, pl. lxx, figs. 10-14.

No record of this well defined species has been published since it was first described from specimens collected in three fathoms at Chuaka, Zanzibar. Specimens agreeing with Water's description and figures have been collected for the Australian Museum at Daru Island, in Torres Strait, New Guinea.

Affinities.—Although Waters considered his species *chuakensis* had much in common with *P. dorsiporosa* from Torres Strait, he thought there were sufficient differences between them to justify the establishment of the new specific name. I believe them to be quite distinct.

It may be noted here that *dorsiporosa* is much more closely related to *japonica* than *chuakensis*.

Locality.—Daru Island, in Torres Strait, south-western Papua; collected by the late Allan R. McCulloch, 5th November, 1922. According to Mr. McCulloch's diary, all natural history specimens from Daru were collected on a mud flat alongside the jetty. Though largely consisting of soft silt, it included a platform of mud-stone or hardened mud, which was covered at low water, and upon which were many crabs and other invertebrates.

STUDIES IN AUSTRALIAN CARCINOLOGY.

No. 2*

By

Frank A. McNeill, Zoologist, Australian Museum.

(Plates ix-x and Figures 1-4.)

A Revision of the Family Mictyridae.

In the present paper an effort has been made to revise the family Mictyridae, and to assemble under one heading the literature concerning the species of the monotypic genus *Mictyris*. Large series of specimens in the Australian Museum collection afford an opportunity to elaborate upon the subject, and to submit previously unconsidered data concerning the genotype *Mictyris longicarpus* Latreille. Stress has been laid on the unique distribution of this species, and Stimpson's *M. brevidactylus* has been regarded as a distinct variety of it. A new species has also been added, which occurs within the eastern Australian range of *M. longicarpus*, living in association with it on the same tidal flats.

The compilation of the paper has been materially aided by the kindness of Dr. Mary J. Rathbun of the United States National Museum, Dr. W. T. Calman of the British Museum (Natural History), and the authorities of the South Australian Museum; the two former for their ready assistance and advice and the latter for allowing me to examine their collection of *Mictyris* spp. Thanks is also extended to Mr. T. Iredale of the Australian Museum for valuable data concerning the activities of early scientific expeditions to Australia, and for some references to literature otherwise unavailable to me.

Apart from a few references to old works of the dictionary or encyclopedia type which have come under my notice, and contain only repetitions of the more important publications, there appears to be only three works which are not available to me for consultation. These are:—Aurivillius, Zur. Biol. Amphib. Dekap., p. 38, pl. iii, figs. 10-11 (Mitg. K. Ges. Wiss. Upsala, 1893); Nauck, Zeits. Wiss. Zool., xxxiv, 1880, p. 22, pl. i, figs. 5-7 (gastric teeth); and the 3rd edit. of Cuvier, which is referred to elsewhere in the text. A further reference to "*Mélanges Carcinologiques*, p. 118" (*fide* Stimpson, 1858 and A.M.E., 1873) is thought to refer to an unpublished MS.

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*For No. 1, see Rec. Austr. Mus., xiii, 3, 1920, p. 105.

Family MICTYRIDAE.

In view of the interesting discussion on the aberrant characters of the unique genus *Mictyris*, as given by Kemp,[1] I feel that it rightly deserves the family rank to which it was evidently first elevated by Dana,[2] and which has not yet received universal recognition.

Genus MICTYRIS *Latreille.*

Latreille, Genera Crust. et Insect., tome 1, 1806, p. 40 (*longicarpus*).

Definition.—Carapace elongate, globose, oval but truncated posteriorly by the short and almost straight posterior border; the cervical and cardio-branchial grooves well developed, and making the regions distinct and convex; the posterior border fringed with bristles, as is also the apposed very prominent edge of the first abdominal tergum.

The afferent branchial orifice is a singular valvular recess, formed dorsally by a semicircular notch in the margin of the carapace, and ventrally by a curious cup-shaped dilatation of the base of the epipodite of the external maxillipeds.

Front a narrow deflexed lobe as in *Ocypode*. Orbits represented by a small post-ocular spine, and the eyes, which are borne on shortish stalks, are quite unconcealed.

Antennules as in *Ocypode*, the basal joint being large and exposed, while the flagellum is rudimentary and concealed beneath the front. Antennae small but well formed, standing in the usual position.

Epistome short, lozenge-shaped. Buccal cavity enormous, and somewhat oval in outline. External maxillipeds very large and foliaceous, with a hemispherical bulge causing them to face as much laterally as ventrally; their greater part is formed by the ischium, the inner margin of which is hairy, especially at the base; the merus is very much smaller than the ischium, and carries the coarse hairy flagellum at its antero-external angle; the exognath is small, slender, and very inconspicuous.

Chelipeds moderately long and rather slender, stouter and a little shorter than the legs; their freest motion is in a vertical plane. The wrist is a rather elongate trigonal obconical joint.

Legs somewhat compressed; the first pair are the longest and the others decrease slightly in length in posterior succession.

The abdomen in both sexes is of a broad truncate oval shape, the segments from the second to the sixth gradually increasing in length, and the seventh much narrower. In both sexes the abdomen is fringed with hairs.

This definition is mainly after Alcock.[3]

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[1] Kemp—Rec. Indian Mus., xvi, v, 1919, p. 307.
[2] Dana—United States Explor. Exped., Crust., i, 1852, p. 389.
[3] Alcock—Journ. Asiat. Soc. Bengal, n. ser., lxix, 2, No. 3, 1900, p. 383.

MICTYRIS LONGICARPUS *Latreille.*

(Plate ix and Figure 1.)

Crab, White, J., Journ. Voy. N.S. Wales, 1790, p. 260 and fig. 3 on opposite plate.

Mictyris longicarpus Latreille, Genera Crust. et Insect., i, 1806, pp. 40 and 41.

Mictyris, sp. nov.[4] Latreille, in Cuvier's Règne Animal, iii, 1817, p. 21.

Myctiris longicarpus Latreille, Tableau Encycl. et Méthodique, Crust., Arach. et Insects, pt. xxiv., 1818, pl. 297, fig. 3, explication des planches, p. 3.

Mictyris longicarpus Latreille, Nouv. Dict. d'Hist Nat., xx, 1818, pp. 522 and 523.

Mictyris longicarpa Schinz, Das Thierreich [Cuvier], iii, 1823, p. 28.

Mictyris longicarpus Desmarest, Dict. Sci. Nat., xxviii, 1823, pp. 235 and 236, and plate xi, fig. 2 of the Crustacés in the planches of the Dict. Sci. Nat., 1816-1830; Consid. Générales des Crust., 1825, p. 115, pl. 11, fig. 2. *Id.*, Guérin, Dict. Classique D'Hist. Nat., x, 1826, p. 549 (part — ? *Amboina record*).

Mictyris longicarpius Guérin, Iconographie du Règne Anim. de Cuvier, iii, 1829-1844, Crust. plate iv, fig. 4.

Ocypode (*Myctiris*) *longicarpius* De Haan, Siebold's Fauna Japonica, Crust. 2, 1835, p. 25.

?*Ocypode* (*Myctiris*) *deflexifrons* De Haan, *tom. cit.*, 1835, p. 25 (*sine descr.*).

Mictyris longicarpus Guérin, Dict. Pitt. D'Hist. Nat., v, 1837, p. 316, pl. 362, fig. 2.

Myctiris longicarpis H. Milne Edwards, Hist. Nat. Crust., ii, 1837, p. 37. *Id.*, Lamarck, Hist. Nat. Anim. sans Vert., 2nd edit., v, 1838, pp. 408 and 409.

Mictyris longicarpus Lucas, Hist. Nat. Crust., 1840, p. 61.

Myctiris longicarpus White, A., List Crust. Brit. Mus., 1847, p. 34 (part — *not specimen from China*). *Id.*, H. Milne Edwards, Ann. Sci. Nat., Zool. (3), xviii, 1852, p. 154.

Myctiris longicarpis Dana, United States Expl. Expd., Crust. i, 1852, p. 389.

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[4] A few words of definition are completed by the misleading statement, " L'espèce est nouvelle."

Myctiris longicarpus Stimpson, Proc. Acad. Nat. Sci. Philad., 1858 (1859), p. 99.

Myctiris longicarpis Lucas, in D'Orbigny's Dict. Univ. d'Hist. Nat., viii, 1861, pp. 496-497. *Id.*, Hess, Archiv fur Naturg, xxxi, 1865, p. 142.

Myctiris longicarpus Heller, Reise der "Novara," Zool., ii, 3, 1868, Crust. p. 40.

Myctiris longicarpis Tozzetti, Bull. Soc. Entom. Italiana, Firenze, iv, 1872, p. 393.

Myctiris longicarpus A. Milne Edwards, Nouv. Arch. Mus. D'Hist. Nat., ix, 1873, p. 276. *Id.*, Tozzetti, Pub. R. Istit. Stud. Super., Firenze, i, Crostacei "Magenta," 1877, p. 185, pl. xi, figs. 5, 5a-e.

Mycteris longicarpus Haswell, Cat. Austr. Crust., 1882, p. 116. *Id.*, Miers, Zool. "Alert," 1884, p. 248 (part — *?specimens from Billiton Is. and Timor Laut, not specimens from Negros, Philippine Ids. and China seas*); "Challenger" Zool., xvii, 1886, Brachyura, p. 278.

?*Myctiris longicarpus* De Man, Archiv für Naturg., liii, I, 1887, p. 358.

Mycteris longicarpus Whitelegge, Journ. Roy. Soc. N.S. Wales, 1889, p. 230.

?*Myctiris longicarpus* De Man, Notes Leyden Mus., xii, 1890, p. 83 (without locality).

?*Myctiris longicarpus* Henderson, Trans. Linn. Soc. London, Zool., (2), v, 10, 1893, p. 390.

Myctiris longicarpus Thallwitz, Kön. Zool. Mus. Dresden, Abhand., 1890-91, No. 3, (1892), p. 52. ?*Id.*, Ortmann, Zool. Jahrb., Syst., vii, 1894, p. 748 (part—*not specimens from Hongkong*).

?*Myctiris brevidactylus*, Zehntner, Revue Suisse Zool. et Ann. Mus. D'Hist. Nat. Geneve, ii, 1894, p. 177, pl. viii, figs. 21 and 21a.

Myctiris longicarpus Zehntner, *tom. cit.*, 1894, p. 177, pl. viii, figs. 22 and 22a (no locality). ?*Id.*, Ortmann, Semon's Zool. Forschungsr. Austr., v (Denkschr. med.—naturw. Gesellschaft, viii), 1894, p. 58.

Mycteris longicarpus Saville-Kent, Naturalist in Austr., 1897, p. 241, and figs. on p. 242 (including illust. of "*Mycteris platycheles*"). *Id.*, Stead, Zoologist (4), ii, London 1898, p. 207.

Myctiris longicarpus Nobili, Ann. Mus. Civico Storia Nat. Genova (2a), xx (xl), 1899, p. 272.

?*Mictyris longicarpus* Alcock, Journ. Asiat. Soc. Bengal (n.s.), lxix, 2, No. 3, 1900, p. 384. ?*Id.*, De Man, Abh. Senck. Naturf. Ges., xxv, 3, 1902, p. 499.

Mictyris longicarpus Grant and McCull., Proc. Linn. Soc. N.S. Wales, xxxi, 1, 1906, p. 23.

Myctiris longicarpus Stimpson, Smith. Misc. Coll., xlix, No. 1717, 1907, p. 102 (a posthumous paper published at the instigation of Dr. Mary J. Rathbun).

Mictyris longicarpus Rathbun, Proc. Zool. Soc. London, 1914, 3, p. 661. ?*Id.*, Tesch, "Siboga" Expd., Monogr. xxxix c, Decapoda Brachyura I, 1918, p. 42.

Myctiris longicarpus Parisi, Atti. Soc. Ital. di. Sci. Nat. Mus. Civico, Milano, lvii, 1918, p. 100 (part—*specimens from "Australia" only*).

Description.—Body sub-globular, its width appreciably less than its length between the front and the hinder margin of the carapace, and not quite reaching as far forwards as the bases of the antero-lateral spines; breadth 1.2 in the length. Branchial regions moderately swollen, not overlapping the lower edges of the carapace at the bases of the ambulatory limbs. Posterior border truncated, and conspicuously produced beyond the curve of the abdomen, its width less than the interspace between the antero-lateral spines, and the interspace between the extremities of the eyes; the lateral margins rounded.

Carapace smooth to the touch. Branchial regions with minute, closely set microscopic granules, which are a little more abundant here than on the median areas. A pair of rounded tubercules between the anterior portions of the branchial regions. Regional grooves well defined, deeply furrowed in parts in the example described, but variable in other specimens. Subhepatic regions visible from above. Antero-lateral spines prominent, recurved, and directed obliquely upward and outward, each with an ill-defined microscopically granular ridge[5] extending backwards between them and the branchial regions, and another short microscopically granular ridge extending from the outside base of each onto the subhepatic regions.

Eyes large and globose, the space between their tips greater than the width of the produced hinder margin of the carapace, and equal to the space between the mid-branchial regions. Front vertical and channelled, its depth between the eyes equal to its width; the median lobe is obtusely pointed, the obtuse lateral angles are a little produced (see figure 1), and the sides sinuate.

Outer maxillipeds large, their greatest length about one third longer than the interspace between the antero-lateral spines, and almost as long as the upper palm and movable finger of the hand. The length of the merus is slightly less than half that of the naked surface of the ischium.

The first segment of the abdomen is narrower posteriorly than at its articulation with the posterior border of the carapace. The successive

[5]The figure of the species on Plate ix shows this as a hard line, due to an error in draftsmanship.

segments increase in breath to the fifth; the sixth is narrower, but more than twice as wide as the seventh. This last is rounded, and slightly longer than the sixth.

Ischium of each cheliped with a large spine directed forwards. Lower outer margin of each merus with one stout spine on its distal half, and two or more smaller ones behind. Outer surface of merus sparsely granular above and below the median area, which is smooth except for some microscopic hair pits; the upper half is faintly furrowed transversely.

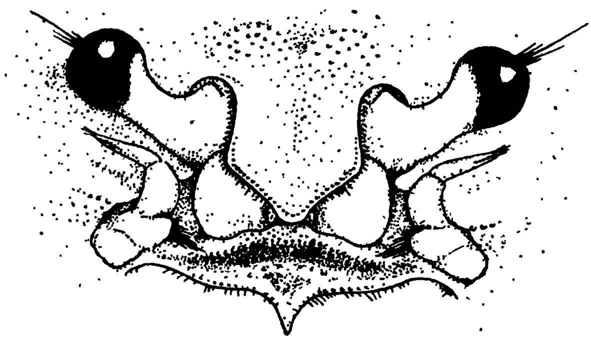

Fig. 1. *Mictyris longicarpus* Latr. view of front and rostrum of an adult male. Example from Trial Bay, New South Wales.

Wrist and outer surface of the palm smooth to the touch, the former even clothed with minute microscopic granules, the latter sparsely so. Both with shallow transverse furrows as in the merus. The upper margin of the wrist clearly serrated. The depth of the palm is equal to the length of its lower margin, and is about three-quarters the length of the immovable finger; the upper margin is very finely serrated. A shallow groove extends along the upper surface of the palm, defined above by an obtuse scarcely granular ridge; an oblique scarcely granular and narrow ridge extends backwards and downwards across the palm from the base of the movable finger, and a similar ridge extends downwards and forwards to form a keel on the side of the immovable finger. A well-defined scarcely granular ridge is present near the outer edge of the lower surface of the palm, and continues forwards to form the lower edge of the immovable finger; another less defined but similar ridge on the inner edge of the palm extends forwards to form the inner edge of the immovable finger, and defines the edge of a groove which runs along the mid-ventral surface of the finger. Movable finger not quite as long as the wrist, immovable one conspicuously shorter. The movable finger has a groove along its dorsal surface, which is defined by two low ridges running almost the length of the finger; the outer one is finely serrated, the inner scarcely so. Another ridge runs from the base of the movable finger and forms a keel on its outer surface. Both fingers meet at a little distance from their extremities. The movable finger curves inwards to a greater extent than

the immovable one, which is turned slightly outwards towards its tip ; the latter finger is widened towards its extremity in the specimen here described and figured, but this minor character is variable in other examples from the same locality. The cutting edge of the movable finger is armed with a strong smooth tooth near its base, and several serrations are present on the cutting edge of the immovable finger near its base.

Ambulatory limbs long and slender. The merus of the last pair is sparsely covered with microscopic granules. These are also present on the meri of the remaining three pairs, but are conspicuously enlarged towards the dorso-posterior edges. Each merus also possesses a finely serrated ridge on its antero-dorsal and ventral edges, and a similar ridge is present on the postero-ventral edge ; these are more pronounced on the three anterior pairs of limbs. Carpus and propodus almost smooth, except for some shallow transverse furrows which are more evident on the merus. Dactyls smooth and triangular in section, the fourth pair more slender than the others, and slightly curved outwards towards the tip. Merus of the third pair of limbs slightly longer than the first to sixth segments of the abdomen.

Colour.—When alive, the conspicuous dorsal colour of the body of *M. longicarpus* is sky-blue. Abdomen and outer maxillipeds of the same hue, but lighter, and the sternum white. Branchial regions creamy white. Limbs white underneath, with some fine streaky light brown lines across the upper sides of the meral and carpal joints ; on the chelipeds these lines extend onto the palms. Junction of ischial and meral, and meral and carpal joints of ambulatory limbs strongly marked with patches of dark brown, sometimes purplish brown ; these patches are less conspicuous on the females. Similar patches of colour occur on the chelipeds at the junction of the meral and carpal joints, but are not so conspicuous here as on the other limbs.

One unique individual observed was white along the middle of the carapace, and the branchial regions were coloured yellow. Another was coloured yellow with streaks of sky-blue along the middle of the carapace, and the branchial regions were a bright orange hue. The foregoing, however, are only freakish colourings which are usually rare in their occurrence.

Described and figured from an adult male example collected in Port Jackson, New South Wales, and measuring 24.5 mm. between the front and the hinder margin of the carapace, and 20.5 mm. across the branchial regions. These dimensions represent the average size of the adult males occurring on the coast of New South Wales, but as the tropics are approached they appear to diminish somewhat in bulk. This is particularly noticeable in a series of 23 adult males from Port Darwin, and is a condition prevalent in some Australian tidal flat Ocypodids, evidently due to an unfavourable environment.

Occurrence and habits.—*M. longicarpus* is a gregarious species, and congregates in vast armies on the tidal sand flats of estuarine waters.

Many of the flats in Botany Bay, New South Wales, are composed of a mixture of sand and mud (silt) particularly suitable to the crabs, and observations in this locality have shown them to be particularly plentiful during the warmer months between November and March. When the tide is out they are seen to be moving slowly about in massed groups of thousands of individuals. If followed at a little distance they will become alarmed and break up their compact formations in order to effect individual escape from impending danger. In this wild scramble the crabs walk and run over each other, two, three, and sometimes four deep. The rush continues until a softer part of the flat is reached, where they are enabled to commence "cork-screwing" movements and quickly disappear below the surface.

The peculiar burrowing actions are very interesting to watch, and, along with those of the other species of the genus, are probably unique among the Decapoda. Beginning with the chela and ambulatory legs of either the left or right side, the crab digs deeply into the yielding surface of the sand; these limbs then begin a forward scooping motion, assisted meantime by the limbs of the opposite side, which are used as levers against the sand, moving backwards as progression increases. The side of the body on which the crab had begun to burrow soon becomes partly sunken, and the real work of excavation then commences. The bulk of the task is performed by the anterior ambulatory limb and cheliped of the lower side. The outer palm of the latter appendage is pushed forwards against the sand, and the material dislodged in this manner is passed under and across the front of the body with the aid of the first ambulatory limb. Having now reached the opposite side of the body, the sand is shovelled backwards and upwards by the inner palm of the other cheliped. The three remaining limbs on the lower side continue a forward digging motion with the limbs in front, while the four ambulatory limbs on the upper side take backward steps, digging their dactyls into the sand, and, acting as levers, contribute their share to the work of excavation. When the crab has burrowed as deep as the width of its body the upper posterior limb becomes doubled up over the carapace to such an extent that only the tip of its dactyl is able to touch the sand as its owner performs its spiral burrowing "walk." Soon this limb becomes useless for further action, as it is forced into such a dorsal position that it can no longer lever against the sand, and remains so during the rest of the burrowing.

When burrowing, a crab can disappear from sight in comparatively hard sand in about ten seconds, and only takes half this time in softer places. It evidently continues its rotary movement until a depth of six to nine inches is reached; the excavation of specimens has proved that the distance they burrow from the surface varies irrespective of the size of individuals. In some instances crabs were found to have moved several inches to the side of their recent perpendicular line of retreat, but this was only in places where the soft watery sand was very near the surface. The only indication left to show where a crab has lately burrowed is a circular sunken convexity on the surface, which persists before smoothing over for varying lengths of time, according to the consistency of the sand.

As the incoming tide covers the flats the crabs disappear into the sand until the water recedes again. They work their way upwards as the tide ebbs and evidently loiter to feed below the crust of the sand. Prior to their reappearance on the exposed flat numerous conspicuous hummocks of disturbed sand can be observed, which indicate the subterranean operations of one or more individuals just before breaking through the surface. These hummocks may be simple in structure or composed of one or more short radiating tunnels roofed in by loosely packed sand ; they often occur so thickly on a flat that it is difficult to distinguish one from the other. Then, as though in answer to some unexplainable instinct, great numbers will appear above the surface of the previously barren sand. They immediately congregate and begin feeding by scraping the surface of the flats and passing the material thus gathered to their jaws, where it is carefully sieved for the contained food particles.

Saville-Kent (*loc. cit.* 1897) states that the external maxillipeds are largely responsible for the spiral motion communicated to the body of the burrowing crab, and, as a consequence, lays stress on the importance of their structure. He states that their inferior edges are driven foremost into the sand, but I did not observe any movement of the maxillipeds of burrowing crabs and it is highly improbable that such delicate structures could assist their owner in so hard a task. Further, it would be necessary for the crab to separate these external jaws widely before they were free of the end of the abdomen. If brought into play against the sand while in this position they would be hopelessly clogged, and tend to retard rather than assist burrowing.

A noticeable fact about *M. longicarpus* is the scarceness of females in the numerous series examined. This suggests that they do not congregate on the surface of the flats to the same extent as the males, which is a question I have unfortunately neglected to verify in the field.

The foregoing notes disagree in one particular with those published by Cowles[6] for " *M. longicarpus* " (= var. *brevidactylus*) from the Philippines. This author states that the hummocks are formed by the crabs when feeding on the surface, while in the Botany Bay examples observed the hummocks or mounds were made prior to the crabs congregating on the recently exposed flats. On the other hand, an opportunity of verifying another of Cowles' statements was afforded by the careful excavation of several crabs from sand immediately after being exposed by the outgoing tide. These examples were found to be in cavities larger than their bodies and the imprisoned air in them escaped in bubbles through the very moist sand.

Sexual dimorphism.—The adult females in all the series before me are only about two-thirds the size of their consorts. They agree with the males in all essential characters, but are not so sturdy, the chelipeds are more evenly covered with granules, and the fingers are slender; the movable one always without a tooth on its cutting edge.

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[6]Cowles—Philippine Journ. Sci., x, section D, 1, 1915, p. 14.

Variation.—Along the eastern Australian coastline the adults of the species are consistent in all major structural details. A very slight variation is noticeable in the character of the front, some specimens having the lateral lobes more obtuse and the median lobe more or less pointed. In young examples, however, slight differences occur which are consistent irrespective of sex. These have a more evenly convex carapace than the adults, the branchial regions being ill-developed, and the regional grooves ill-defined.

In specimens from the northern coastline of Australia some small variable characters are exhibited in series of specimens from different localities. Six of a total of eight adult male specimens from Groote Eylandt in the Gulf of Carpentaria possess two well developed spines, one on each of the two lower margins of the merus of the cheliped ; these are situated opposite one another on the distal half, and the one on the inner margin may be bicuspid or followed by another smaller spine. With the exception of the secondary spine on the inner margin of each merus, the same character is also apparent in the majority of eleven small male specimens from the general locality " Northern Territory," but in six males of a batch of larger sized specimens from Palmerston, Northern Territory, there is no spine developed on the inner margin of the merus. The above character is also absent in thirty one adult male examples from Cygnet Bay on the north western coast, and in two other batches of four and five specimens from the general locality " North West Australia." It is in the material from the north west coast that one finds the greatest divergence from the typical form. The specimens from there approach *brevidactylus* in some features, and may be said to represent an intermediate form. The differences, however, are considered inadequate for the creation of a new varietal name. The major points of variation in the adult males of these series are :—Median area of carapace smooth, with irregularly disposed areas of granules visible to the naked eye on dried examples ; in places these are arranged in groups composed of three or four granules. The closely set granules on the branchial regions tend to form rugae on the posterior halves. Antero-lateral spines highly granular around their bases and on their anterior faces, with a strong granular ridge connecting their bases with the branchial regions. Lateral angles of front consistent in character, being very obtuse and not produced. Eyes much smaller than in the typical form, the outer margin of each merus of the chelipeds often with only one stout spine on its distal half, rarely more. Sometimes this is armed with one or two small subsidiary teeth which give the structure a crude tricuspid appearance. Outer surface of merus of chelipeds strongly granular above and below the median area ; faintly furrowed as in the typical form. Wrist strongly granular ; outer surface of palm sparsely covered with strong granules tending to form a reticulated pattern ; all the ridges are well defined and strongly granular. Both ridges on the dorsal surface of the movable finger serrated. Teeth on the cutting edge of the movable finger occasionally with some posterior indications of serration. Both fingers more tapering than in the typical form. Dactyls of fourth pair of ambulatory limbs markedly curved outwards towards their tips.

History.—The vague locality " Oceano Indiæ orientalis " was given to *M. longicarpus* by Latreille when he described the species in 1806 from a specimen or specimens in the Paris Museum. Most of the essential characters were embodied in this original diagnosis, and a somewhat crude figure of the species was prepared in 1818 under Latreille's direction, which, nevertheless, clearly shows these features. The posterior border of the carapace is depicted as being almost straight, but an ill-defined prolongation can be distinguished when the engraving is closely examined.

In the same year that the above figure appeared, Latreille again wrote on *M. longicarpus*, and supplied some new and valuable data as to the origin of the species, viz., " recueillie dans les Indes Orientales, par Péron et M. Lesueur."

Later, Desmarest was responsible for the appearance in 1823 of a good figure of *M. longicarpus*, in which all the characters were well depicted, including the prolongated posterior border of the carapace. This same illustration appeared again in 1825 in the separate bearing Desmarest's name.

In 1826 Guérin gave the following information concerning *M. longicarpus*.—"a été rapporté des Indes-Orientales par Péron et Lesueur. Lesson et Garnot l'ont recueilli sur les côtes de la Nouvelle-Hollande et à Amboine." Following on this there appeared a note on *Mictyris* by Latreille in 1829,[7] which he concludes by giving the amended locality "l 'Océan australasien." Guérin's Inconographie was published about this time, and a fine new figure of *M. longicarpus* appeared, which truthfully presents the striking posterior extension of the carapace. This was supplemented by a similarly characteristic figure supplied by the same author in 1837.

It is apparent from literature that another good figure of *M. longicarpus* appeared about the same time as the last named in the crustacea section of the " Disciples edition " of Cuvier,[8] but unfortunately this is not available to me for comment.

In the same year as Guérin's last figure of *M. longicarpus* appeared (1837), H. Milne Edwards altered the general habitat of the species to " Australasie," and still later (1852) amended it to " Australie," when he described his species *M. platycheles*.

Identity.—It is obvious that the figure of *M. longicarpus* provided by Desmarest must have been prepared from Latreille's original specimen or series of specimens, and at that time (1823) the only one available in France. This was the second illustration of the species to appear, and served to rectify any omissions in Latreille's crude original figure. Desmarest's illustration clearly shows the characters of the common eastern Australian " Soldier Crab," and there can be little doubt as to the identity of Latreille's *M. longicarpus*.

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[7] Latreille—Cuvier's Règne Animal, 2nd edit., iv, 1829, p. 47.

[8] H. Milne Edwards—Cuvier's Règne Animal, 3rd [" Disciples' "] edit., 1836-1849, Crustacea, pl. xviii, fig. 2.

A close study of the literature provides sufficient evidence for a conclusion that Latreille's original material of *M. longicarpus* came from an Australian locality. The possibilities of the important disclosure that Péron and Lesueur collected it have not previously been fully considered. Among other groups are a considerable number of typical Australian forms credited to the Indian Seas and East Indies by these voyagers, *e.g.*, *Megatebennus javanicensis* Lamarck,[9] a common Tasmanian mollusc which is also recorded from New South Wales.

The localities visited by Péron and Lesueur[10] in the seas of Australasia included Timor, Shark Bay and King George's Sound in Western Australia, Kangaroo Island off South Australia, King Island in Bass Strait, Adventure Bay in Tasmania, and Port Jackson in New South Wales. As far as I am aware *M. longicarpus* has not been recorded from Timor, which suggests that it does not occur there, or is not thriving in the accessible parts. Further, the species has not been recognised from the southern part of the Australian continent apart from a unique record of Miers' (*loc. cit.* 1884), giving the general locality " Tasmania," which I consider to be of very doubtful value. There is a possibility that the species was collected at Shark Bay, where, judging from its distribution, it must be very common. Apparently, large collections of marine forms were made at this last locality by Péron and Lesueur, and it is unlikely that the species could be overlooked if present. On the other hand, Port Jackson is a veritable stronghold of *M. longicarpus*, and, although Péron's narrative does not include any glowing accounts of its fauna, there is every reason to believe that such an obtrusive species as this would not be overlooked. Moreover, Desmarest's figure of the species compares better with the Port Jackson examples before me than with a number of specimens from Cygnet Bay, a Western Australian locality somewhat farther north than Shark Bay. As already pointed out in the notes on variation the Cygnet Bay specimens vary somewhat from the Port Jackson examples in that their carapaces are visibly granular, and their eyes minute, whereas the Port Jackson specimens have comparatively smooth carapcaes and large eyes as depicted in Desmarest's figure.

The foregoing arguments in support of an Australian origin for Latreille's type material of *M. longicarpus* are strengthened by that author's action in later (1829) altering the habitat of his species to " l' Océan australasien." The advent of Lesson and Garnot's material as recorded by Guérin three years earlier may have been responsible for Latreille's action. No other reference to the fact that Lesson and Garnot collected *M. longicarpus* appears to have been published, and, as Port Jackson in New South Wales is the only locality they collected at in " Nouvelle-Hollande " —during the voyage of the " Coquille "—it is certain that the record here referred to applies to the typical eastern Australian *M. longicarpus*. The same can also be said of Guérin's two subsequent figures of the species, which in all probability were prepared from

[9]Hedley—Journ. Roy. Soc. N.S. Wales, li, 1917 (checklist Marine Fauna N.S.W.), p. m.40. Proc. Linn. Soc. N.S. Wales, xxix, 1904, p. 204 ; xxxviii, 1913, pp. 270-271.

[10]Péron—Voy. de decouv. aux Terres Australes, 2 Tom. and Atlas. 4to and fol. Paris, 1807-16.

the more recent and perhaps better specimens brought back from Port Jackson by Lesson and Garnot.

The action of H. Milne Edwards in eventually amending the general habitat of *M. longicarpus* to " Australie " was evidently a carefully considered procedure, as we can only assume that it was done in an attempt to more truthfully localise one of the many species of vague origin in the jumbled collections secured during the ill-fated expedition of Péron and Lesueur.

Synonymy and distribution.—The crab figured in White's Journal (*loc cit.* 1790) is undoubtedly referable to *M. longicarpus.* No name was given to the species by this author, and the only information offered at the time was—" A small species of Crab or Cancer, of a pale colour, and which should be ranked amongst the Cancri Brachyuri in the Linnæan division of the genus." Furthermore, no reference was made to any specific locality, but there is no doubt that all the forms described by White were secured at Port Jackson, New South Wales, or in close proximity thereto.

It has already been noted that some slight but certain variation exists in specimens of *M. longicarpus* from North Western Australia. This fact, coupled with the evidence available from literature, enables some deductions to be made which will probably help future workers to understand better the unique distribution of the species, and its ultimate development into what is considered here to be a distinct varietal form (*brevidactylus*).

Unfortunately, most of the references to *M. longicarpus* are based on specimens from a vast East Indian area, and it is these records that have formed the basis of former discussion. It is evident that the species is subject to no little variation in the above mid-region of its range, and after an exhaustive study of large series of specimens it may be proved that definite racial forms exist there in circumscribed areas.

De Haan was the first indirectly to bring under notice the fact that *M. longicarpus* is variable, when he published the *nomen nudum* " *deflexifrons* " in 1835.[11]. In 1894 Zehntner identified some specimens from Amboina as Stimpson's *brevidactylus*, and gave comparative characters and figures separating them from typical *M. longicarpus* as it is here understood. Nevertheless, there is insufficient evidence to satisfy me that his record correctly referred to the *brevidactylus* finally described and figured by Stimpson in his posthumous paper of 1907. It is possible that Zehntner, upon finding differences between the two forms he examined, was encouraged by Stimpson's suggestion that *brevidactylus* was synonymous with De Haan's " *deflexifrons*," which led him to the belief that the Amboina material in his possession was correctly referable to Stimpson's

[11]Published with a reference to " Illustr. Reinwardt ex Insulis Moluccensibus," which consists of a collection of unpublished paintings in the Leyden Museum, Holland.

so called species.[12] Unfortunately he did not record the source of the examples of *M. longicarpus* used for his comparative notes, and thus robbed us of further data concerning the distribution of what is quite obviously the typical form as here understood.

It is worthy of note that De Man (1887) was in possession of material from Amboina similar to that examined by Zehntner. He suggested that the characters of his specimens approached those described by Stimpson for *brevidactylus*, but nevertheless was of the opinion that Stimpson's "species" was identical with *M. longicarpus*. It was admitted, however, that Stimpson cited the latter species—an important fact that may well be emphasised here. When Stimpson described *brevidactylus* he was in possession of specimens of typical *M. longicarpus* (*loc. cit.* 1858 and 1907) which he personally collected in Port Jackson and Botany Bay, New South Wales.

Tesch (1918) states that he has examined De Haan's original specimens of "*deflexifrons*," and identifies them with *M. longicarpus*. He lightly disposes of Zehntner's arguments in support of the distinctness of Stimpson's *brevidactylus*, and states that "the 'Siboga' specimens at least could, by a mixture of characters, be referred to either of the two species" (*M. longicarpus* and var. *brevidactylus*). From the foregoing it is presumed that Tesch had not the opportunity of examining specimens of *M. longicarpus* from the eastern Australian coastline. If so, he may have placed a little more value on Zehntner's argument, and given some valuable information concerning the variation of *M. longicarpus*.

In dealing with the references to *M. longicarpus* it has been found necessary through the lack of convincing data to query those relating to Indian and East Indian records, but for the purpose of var. *brevidactylus* all references to records from the Philippine Islands and northwards thereof have been regarded as rightly applicable thereto.

The distribution of *M. longicarpus* together with the var. *brevidactylus*, ranges from the lower New South Wales coast and Perth, Western Australia, in the south, to Loo Choo Islands, China Sea, in the north ; and

[12]On the other hand, if it is later proved that the representatives of *Mictyris* from the nearby Moluccas are synonymous with *brevidactylus* or another racial form possessing sufficient distinguishing characters to separate it from this and typical *M. longicarpus*, the validity of De Haan s "*deflexifrons*" may be reviewed.

In anticipation of this possible contingency, and despite the fact that I here accept De Haan's name as a *nomen nudum*, others may place a different value on the facts.

De Haan in 1835 (*loc. cit.*) recorded *Mictyris* as a subgenus of *Ocypode*, and gave a diagnosis (mainly on mouth parts) of the genus based on specimens before him, which appear to have been his "*deflexifrons*, sp. nov.," as the figures provided in the series depicting the mouth parts of different genera bear this name. The name "*deflexifrons*" also appears at the end of the generic diagnosis, after that of "*Ocypode* (*Myctiris*) *longicarpius*, Latr." Although figures were given, no definite specific description was offered by De Haan for "*deflexifrons*," and it is questionable whether the regional drawings of no distinguishing value in association with a locality, and the assumption that the diagnosis was based upon the same specimens, should validate the name.

from New Caledonia and New Guinea in the east, to the Bay of Bengal, India, in the west.

Localities[13]—? Tasmania (Miers): ?Victoria (Stead)[14]: Botany Bay, N.S. Wales (Stimpson): Sydney and Port Jackson, N.S. Wales (Guérin and White, A. as New Holland, White, J., Dana, Stimpson, Heller, Tozzetti, Haswell, Miers, Whitelegge, Stead, Nobili): Moreton Bay, Wide Bay, Carnarvon in the Gulf of Carpentaria, Queensland; and Roebuck Bay in North Western Australia (Saville Kent): Port Curtis, Queensland (Grant and McCulloch): Port Molle and Albany Island, Queensland; Nicol Bay, N.W. Austr., and Swan River in W. Austr. (Miers): Port Essington, N. Austr. (White, A. and Miers): Beagle Bay and Wolverine Passage, N.W. Austr. (Nobili): Monte Bello Islands, N.W. Austr. (Rathbun): New Caledonia (A. Milne Edwards, Thallwitz, Haswell).

Records from the following localities are tentatively considered to be referable to typical *M. longicarpus*.—Amboina (Guérin, De Man, Zehntner, Ortmann, Tesch): Moluccas (De Haan and De Man): New Guinea, Timor Laut, and Billiton Is. in the Java Sea (Miers): Talaut Is. in the Celebes, and Bawean Is. in the Java Sea (Tesch): Singapore (Ortmann): Andaman and Nicobar Isds. (Alcock): Akyab, Bay of Bengal (Henderson).

There are specimens in the Australian Museum from.—

Lake Illawarra, New South Wales; coll. G. McAndrew, Aug. 1923 (3 adult males): this collection includes a specimen measuring 23 mm. across the branchial regions and 28 mm. from the front to the hinder margin of the carapace, and is the largest examined by me.

Gunnamatta Bay, Port Hacking, N.S. Wales; coll. F. A. McNeill, 1924 (4 adult males).

Port Hacking, N.S. Wales; old collection (1 adult male).

E. side of Botany Bay, N.S. Wales; coll. F. A. McNeill, Dec. 1923 (8 adult males).

N. shore of Botany Bay, N.S. Wales; coll. G. P. Whitley, July 1922 (3 adult males and 1 adult female).

Sailor Bay in Middle Harbour, Port Jackson, N.S. Wales; coll. W. Boardman, 1923 (16 adult and 1 juvenile males), including the figured male example.

Middle Harbour, Port Jackson, N.S.Wales; coll. Dene B. Fry (3 adult males and 1 ovigerous female).

Port Jackson, N.S. Wales; old coll. (2 adult males).

[13]The vague and general habitats associated with the early and subsequent records of *M. longicarpus* are omitted.

[14]Grave doubt is placed on this vague record. I do not believe the species occurs farther south than New South Wales.

Rose Bay, Port Jackson, N.S. Wales; coll. R. Helms, 4th March, 1900 (4 adult males and 1 ovigerous female): the female of this series is the largest of the sex examined; it measures 15.5 mm. across the branchial regions and 19.5 mm. from the front to the hinder margin of the carapace.

Parramatta River, Port Jackson, N.S. Wales; coll. R. Grant, Feb. 1895 (1 adult male).

Clareville Beach, Pittwater in Broken Bay, N.S. Wales; coll. G. P. Whitley, Oct. 1923 (2 juvenile females, one with soft shell).

Hawkesbury River, N.S. Wales; old coll. (2 adult males and one adult female).

Port Hunter, Newcastle, N.S. Wales; old coll., 15th March, 1907 (2 adult males).

Lagoon tidal flats at South West Rocks, Trial Bay, N.S. Wales; coll. J. R. Kinghorn, 1919 (12 adult, 6 half grown, and four juvenile males; 3 adult and 5 juvenile females).

Richmond River near Ballina, N.S. Wales; coll. A. O'Sullivan, 1924 (2 juvenile males and 2 juvenile females).

Richmond River at Ballina, N.S. Wales; coll. R. Etheridge, Jnr., 1893 (6 juvenile males and 2 juvenile females).

N. side of Magazine Island, Port Denison, Queensland; coll. E. H. Rainford, 1923 (22 adult and 1 juvenile males; 1 ovigerous, 3 half grown, and 2 juvenile females).

Townsville, Queensland; coll. Dr. Eland Shaw, Aug. 1925 (3 adult, 2 half grown, and 2 juvenile males).

Endeavour River estuary at Cooktown, Queensland; coll. A. R. McCulloch, 1913 (3 adult and 1 half grown males).

Port Darwin, N. Australia; coll. Messrs. Christie and Godfrey, 1903 (23 adult males).

N.W. coast of Australia; coll. Capt. Walcott, old coll. (8 adult males and 1 adult female).

Specimens from the following localities were kindly lent to me for examination by the authorities of the South Australian Museum:—

Cairns, Queensland; coll. E. Allan (2 adult males).

E. side of Groote Eylandt, Gulf of Carpentaria, N. Australia; coll. N. B. Tindale (8 adult males).

Northern Territory, Australia; old coll. (11 males of small size, but apparently adult).

Palmerston, Northern Territory, Austr.; old collection (4 adult and 2 half grown males; 1 adult and 1 half grown females).

Cygnet Bay, N.W. Australia; old collection (31 adult males).

MICTYRIS LONGICARPUS, var. BREVIDACTYLUS *Stimpson*.

(Pl. ix, figs. 3-4 and Figure 2.)

Myctiris longicarpus White, List Crust. Brit. Mus., 1847, p. 34 (part—*specimen from China only.*)

Myctiris deflexifrons White (*tom. cit.*), 1847, p. 34.

Mycteris deflexifrons Adams and White, Zool. "Samarang," Crust., i, 1848, p. ii of the introduction.

Myctiris brevidactylus Stimpson, Proc. Acad., Nat. Sci. Philad., 1858 (1859), p. 99 (? suggested synonymy).

Mycteris longicarpus Miers, Zool. "Alert," 1884, p. 248 (part—*specimens from China seas and Negros, Philippine Islands only.*)

Myctiris longicarpus Ortmann, Zool. Jahrb., Syst., vii, 1894, p. 748 (part—*specimens from Hongkong only*).

Myctiris brevidactylus Stimpson, Smithsonian Misc. Coll., xlix, No. 1717, 1907, p. 103, pl. xiii, fig. 4 (a posthumous paper published at the instigation of Dr. Mary J. Rathbun).

Myctiris longicarpus Cowles, Philippine Journ. Sci., x, sect. D, No. 1, 1915, p. 14, pls. ii-iii (habits). *Id.*, Parisi, Atti. Soc. Ital. di. Sci. Nat. Mus. Civico, Milano, lvii, 1918, p. 100 (part—*specimens from Formosa only*).

Mictyris longicarpus Balss, Archiv für Naturg., lxxxviii, Abt. A, 11, 1922, p. 144 (?*specimens from Annam*).

The recent acquisition of several specimens of var. *brevidactylus* enables me to compare them with local examples of typical *M. longicarpus*, and to note the striking differences between the two forms. The status of the variety is fully discussed in the text relating to the synonymy and distribution of the typical form (*M. longicarpus*).

Description.—Body sub-globular, its width across the branchial regions hardly less than its length between the front and the hinder margin of the carapace; breadth 1.04 in the length. Branchial regions swollen and overlapping portions of the lower edges of the carapace at the bases of the ambulatory limbs. Posterior truncated border nearly straight, not produced beyond the abdomen as in the typical form, its

width less than the interspace between the antero-lateral spines, but equal to the interspace between the extremities of the eyes; the lateral angles sub-acute. Branchial regions with short, closely set and granular ridges or rugae, and single granules visible to the naked eye; these are separated by finely granular interspaces. Median area of the carapace appearing smooth, but evenly covered with microscopic granules and numbers of scattered groups of larger granules regularly disposed over the surface; a pair of rounded tubercles is present between the anterior portions of the branchial regions as in the typical form. Regional grooves well defined. Sub-hepatic regions visible from above. Antero-lateral spines small, recurved, and directed obliquely upward and outward, with their bases granular; each with a granular ridge extending backwards between them

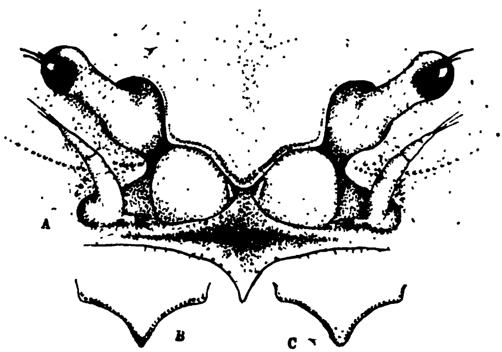

Fig. 2. *Mictyris longicarpus*, var. *brevidactylus* Stimp.

A. View of front and rostrum of an adult male example from Subig Bay, Luzon, Philippine Islands.

B. Rostrum of a female from the same locality.

C. Rostrum of another male from the same locality.

and the branchial regions, and another short granular ridge extending from the outside base of each onto the sub-hepatic regions.

Eyes normal, the space between their tips equal to the width of the hinder margin of the carapace. Front vertical and only faintly channelled, its depth between the eyes about two-thirds its width; the median lobes are obtusely pointed and the sides are almost vertical.

Outer maxillipeds as in the typical form, their greatest length about one-third longer than the interspace between the antero-lateral spines and almost as long as the upper palm and the movable finger of the hand; the length of the merus, however, is only half that of the naked surface of the ischium.

Abdomen as in the typical form, except that the last segment is as long as the sixth.

Ischium of each cheliped with a large forwardly directed spine as in the typical form. Lower outer margin of each merus with one stout spine on its distal half and two or three smaller ones ; its outer surface almost covered with small granules. Wrist and outer surface of palm evenly covered with granules. The upper margin of the wrist clearly serrated. The depth of the palm is equal to the length of its lower margin, and is about three quarters the length of the immovable finger ; the upper margin is serrated. A shallow groove extends along the upper surface of the palm defined above by an obtuse granular ridge ; an oblique, imperfect, and scarcely granular ridge extends backwards and downwards across the palm from the base of the movable finger, and a low granular ridge extends downwards and forwards to form a keel on the side of the immovable finger ; a well defined granular ridge is present near the outer edge of the lower surface of the palm, and continues forwards to form the lower edge of the immovable finger ; another less defined ridge on the inner edge of the palm extends forwards to form the inner edge of the immovable finger and defines the edge of a groove which runs along the mid-ventral surface of the finger. Movable finger as long as the wrist, immovable one shorter. The movable finger has a groove along its dorsal surface which is defined by two finely serrated ridges running almost the length of the finger ; another ridge runs from the base of the finger and forms a keel on its outer surface. Both fingers curve evenly inward, and meet only at their pointed tips. The cutting edge of the movable finger is armed with a strong and broad serrated tooth near its base, and several serrations are present on the cutting edge of the immovable finger near its base.

Ambulatory limbs long and slender as in the typical form. The merus of the third pair is as long as the first to fifth segments of the abdomen. The dactyls of the fourth pair are curved outwards, and triangular in section.

Colour.—Specimens preserved in alcohol are dark slaty-blue on the mid-dorsal regions ; lighter on the branchial regions, with a suggestion of reddish purple in their hue. Limbs and under surface brownish yellow ; viewed through a binocular microscope the limbs are seen to be covered with dark spots which are more conspicuous towards their tips.

Described and figured from an adult male example measuring 11.5 mm. between the front and the hinder margin of the carapace and 11 mm. across the branchial regions. Five other specimens (two males and three females) also before me, measure from 8.5 mm. in length and 7.6 mm. in width, to 12.2 mm. in length and 11.4 mm. in width. The small size of the specimens is due, no doubt, to their existence in an unfavourable environment, a feature which is noticeable in the case of *M. longicarpus*. It is evident that var. *brevidactylus* attains a greater size than the specimens here dealt with, as indicated by the Formosa record referred to below.

Stimpson's types of *brevidactylus* are not extant ; they were lost when the Chicago Academy of Sciences was destroyed by fire in 1871 (*fide* Rathbun in Stimpson, *loc. cit.* 1907, p. 4).

Sexual dimorphism.—The females agree with the males in all essential features, but the ambulatory limbs are not quite as stout, and the chelipeds are weaker. There is no tooth developed on the movable finger of the hand, nor any sign of serration on the cutting edge of the immovable finger. The forwardly directed spine on the ischium of each cheliped is almost obsolete in the females.

Variation.—The branchial regions of the younger specimens are not so thickly covered with granules as in the more adult examples. The rostrum is also subject to slight variation, and may have the median lobe acute or sub-acute irrespective of age (see text figure 2).

Localities.—The following are accepted as referable to var. *brevidactylus,* with perhaps the exception of Balss' Annam records.

China (White, A.); China seas (Miers); Phiippine Islands (White, A. and Cowles); Negros, Philippine Islands (Miers); Meia-co-shimah or Majico-sima, China Sea (Adams and White, A.); Hongkong (Stimpson and Ortmann); Loo Choo Islands, China Sea (Stimpson, Balss): Formosa (Parisi, Balss) and Swatow, China (Balss).

In the Australian Museum collection there are six specimens from Súbig Bay, Luzon, northern Philippine Islands (shore), which were kindly identified and presented to the Institution by Dr. Mary J. Rathbun, and form part of a large series collected on January 7th, 1908, by the United States Bureau of Fisheries, "Albatross" Philippine Expedition, 1907-9.

Dr. Rathbun (*in lit.*) informs me that there is also in the collection of the United States National Museum, Washington, a large specimen of the variety from the Island of Formosa, half way between Loo Choo Islands and Hongkong—Stimpson's type localities.

Distribution.—Philippine Islands and China Sea.

MICTYRIS LIVINGSTONEI,[15] *sp. nov.*

(Pl. x, figs. 1-2 and Figure 3.)

Description.—Body sub-globular, its width across the branchial regions equal to its length between the front and hinder margin of the carapace. Branchial regions only moderately swollen, and not overlapping the lower edges of the carapace at the bases of the ambulatory limbs. Posterior truncated border nearly straight, not produced beyond the abdomen posteriorly, its width equal to the space between the antero-lateral spines; the lateral margins acute. Branchial regions with well spaced short granular ridges or rugae visible to the naked eye, and separated by microscopically granular interspaces; traces of these rugae are also present on the postero-lateral lobes of the cardiac regions. Median area of carapace evenly covered with minute microscopic granules, otherwise almost smooth, with only a few granules and scattered pits, together

[15]Named for Mr. A. A. Livingstone, Assistant in Zoology, Australian Museum.

with a pair of rounded tubercles between the anterior portions of the branchial regions. Regional grooves shallow, less conspicuous than in var. *brevidactylus*. Sub-hepatic regions visible from above. Antero-lateral spines small and directed obliquely outward, with a few granules behind them; no granular ridge extending backwards between each of them and the branchial regions, but a short granular ridge connecting the outside base of each to the sub-hepatic regions.

Eyes very small, the space between their tips less than the width of the hinder margin of the carapace. Front vertical and almost flat, its width between the eyes equal to about two-thirds its length. The median lobe is somewhat truncate in the holotype, but is obtusely pointed in several paratypes.

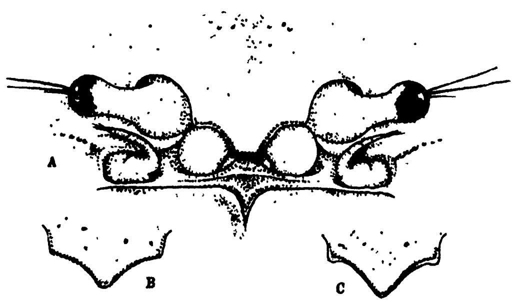

Fig. 3. *Mictyris livingstonei* sp. nov.
A. View of front and rostrum of the adult male holotype.
B. and C. Rostrums of two male paratypes.

Outer maxillipeds smaller than in var. *brevidactylus*, their greatest length but little greater than the distance between the antero-lateral spines. The length of the merus is more than half that of the naked surface of the ischium.

The first segment of the male abdomen much narrower posteriorly than at its articulation with the posterior border of the carapace. The succeeding segments increase in breadth to the fifth, which is twice as wide as the constriction between the first and second; the sixth segment is narrower, but more than twice as wide as the seventh. This last is rounded and is as long as the sixth.

Ischium of each cheliped with a large spine directed forwards. Lower outer margin of the merus with three or four stout spines; its outer surface with scattered granules, almost smooth. Wrist and outer surface of palm with extremely fine, curved, granular lines, forming a scale-like pattern, between which the surface is smooth; there is also a slight indication of these on the outer surface of the merus. The upper margin of the wrist scarcely serrated. The depth of the palm is equal to the

length of its lower margin; a shallow groove extends along its upper surface, defined above by an obtuse ridge; an oblique line of pores extends backwards and downwards across the palm from the base of the movable finger, and a low ridge extends downwards and forwards to form a keel on the side of the immovable finger; a very imperfect ridge is present near the outer edge of the lower surface of the palm, which merges into the edge of the immovable finger; another very strong ridge occurs on the inner edge of the palm, and continues as a ridge along the inner margin of the immovable finger; this defines the inner edge of a groove which runs along the mid-ventral surface of the finger. The movable finger has a rather imperfect groove along a portion of its dorsal surface, defined by an obtuse ridge on each side; another obtuse ridge runs throughout the length of the finger and forms a keel on its outer face. Both fingers are shorter than the wrist and curve evenly inward; they gape widely at the base, and meet only at their pointed tips. The cutting edge of the movable finger is armed with an almost obsolete tooth near its base which is practically indiscernible in half grown males, and there are a few imperfect serrations on the cutting edge of the immovable finger near its base.

Ambulatory limbs shorter, stouter, and less rugose than in var. *brevidactylus*. The merus of the third pair is as long as the first to fourth segments of the abdomen. The dactyls of the fourth pair are curved outwards, and triangular in section.

Colour.—Specimens freshly preserved in alcohol are light slaty blue on the carapace and abdomen. Sternum and under surfaces of the limbs cream coloured; the limbs are brownish yellow above with their margins outlined by dark grey; several of the dactyls and the fingers of the hands are uniformly dark. A few examples show no sign of the dark markings on the limbs and the bodies are much lighter in colour, and possess a reddish tinge on the carapace.

Described and figured from an adult male example measuring 11 mm. from the front to the hinder margin of the carapace, and 11 mm. across the branchial regions; this specimen has been selected as the holotype of the species, and is housed in the Australian Museum, Sydney. There are six other specimens (paratypes) in the collection from the same locality as the holotype. The smallest is one of three females measuring 9 mm. in length and 8. 5mm. in width; the largest of the three remaining males is 11 mm. long and 10.5 mm. wide.

Judging from the large series of specimens before me from two widely separated localities, it is evident that this species is smaller than its allies, and reached its full adult dimensions when about the size of the holotype. There are several females smaller than the holotype that are heavily laden with eggs.

Sexual dimorphism.—The adult females differ slightly from the males in having the carapace more evenly rounded and smoother; the regions

are not so clearly marked off as those of the males, and the branchial regions are less swollen anteriorly. The female chelipeds are much weaker than those of the male, the fingers are straighter, and there is no sign of a tooth on the cutting edge of the movable finger ; the forwardly directed spine on the ischium of each cheliped is almost obsolete in the female. The abdomen of the largest female before me is longer and more convex from side to side than that of the largest male ; the seventh segment is more produced. On the other hand, the abdomens of the smaller females, some with eggs attached, are similar to those of the males.

Variation.—The structure of the front is somewhat variable in the series of specimens before me ; the median lobe may have a semi-truncated extremity as wide as in the holotype, or it may be narrower, and is sometimes sub-acute (see figure 3). In young examples the granulation of the branchial regions is not quite so strongly marked as in the more adult forms.

Affinities.—Although this species resembles *M. longicarpus* var. *brevidactylus* in the granulation of the branchial regions and the shape of the dactyls of the last pair of ambulatory limbs, it may be easily distinguished by the absence of a ridge connecting the antero-lateral spines with the branchial regions, the stouter limbs and smaller eyes, the character of the median area of the carapace, and the less swollen branchial regions, which do not overlap the bases of any of the ambulatory limbs.

Habits and occurrence.—From notes made by collectors in the field it appears that this species has hiding habits, and does not congregate at low tide on the surface of the flats to the same extent as its allies. The comparative smallness of the eyes seems to denote that they are becoming obsolete and tends to strengthen the above belief. All the specimens were dug out of soft sandy mud, and Mr. J. R. Kinghorn of the Museum Staff states that the examples collected by him were at a little distance from the firmer sandy flats frequented by the more numerous typical *M. longicarpus*.

Distribution.—Eastern Australian coast from Cooktown, Queensland, to Trial Bay, northern New South Wales.

Localities.—Lagoon tidal flats at South West Rocks, Trial Bay, N.S. Wales ; about a quarter of a mile from the ocean beach ; collected by J. R. and A. Kinghorn in 1920 and 1921 (holotype and six paratypes).

Mud Flats in the Endeavour River estuary at Cooktown, Queensland ; coll. by A. R. McCulloch in 1918 (nine males and six females).

Mangrove tidal flats at Yeppoon, Queensland ; coll. by. A. Musgrave in October, 1924 (one half grown male).

Port Denison, Queensland. Old collection (two males—one half grown).

Mictyris platycheles *H. Milne Edwards.*

(Plate x, figs. 3-4 and Figure 4).

Myctiris subverrucatus White, A., List Crust. Brit. Mus., 1847, p. 34 (*nomen nudum*).

Myctiris platycheles H. M. Edwards, Ann. Sci. Nat. (3), xviii, Zool., 1852, p. 154. *Id.*, Stimpson, Proc. Acad. Nat. Sci. Philad., 1858 (1859), p. 99.

M. subverrucatus Kinahan, Journ. Roy. Dub. Soc., i, 1858, p. 123 (*fide* Miers, 1884).

Myctiris platycheles? Tozzetti, Bull. Soc. Entomol. Italiana, Firenze, iv, 1872, p. 394.

Myctiris platycheles Tozzetti, Pub. R. Istit. Stud. Super., Firenze, i, 1877, Crostacei " Magenta," p. 186, pl. xi, figs. 6, 6a-e.

Mycteris platycheles Haswell, Austr. Mus. Cat. [v], Austr. Crust., 1882, p. 117. *Id.*, Miers, Zool. " Alert," 1884, p. 248 (and synonymy) ; "Challenger," Rep., Zool., xvii, 1886, Brachyura, p. 279 (and synonymy). *Id.*, Whitelegge, Journ. Roy. Soc. N.S. Wales, xxiii, 1889, p. 230.

Myctiris sp. Thallwitz, Kon. Zool. Mus. Dresden, Abhand, 1890-1891 (1892), No. 3, p. 52.

Myctiris platycheles Ortmann, Zool. Jahrb., Syst., vii, 1894, p. 748.
Mycteris platycheles Saville-Kent, Naturalist in Australia, 1897, p. 241 (not illustration " *Mycteris platycheles* " on p. 242). *Id.*, Stead, Zoologist (4), ii, 1898, p. 207.

Myctiris platycheles Stimpson, Smith. Misc. Coll., xlix, No. 1717, 1907, p. 103, pl. xiii, fig. 5 (and synonymy suggested in text)—a posthumous paper.

Myctiris prostoma Stimpson, *tom. cit.*, 1907, p. 104.

Hymenosoma sp., Geoffrey Smith, Naturalist in Tasmania, 1909, p. 111.

Mictyris platycheles Tesch, " Siboga " Exped., Monogr., xxxix c, Decapoda Brachyura I, 1918, p. 42.

Description.—Body irregularly sub-globular, its width about three-quarters its length between the front and hinder margin of the carapace ; breadth 1.29 in the length. Branchial regions greatly swollen, particularly towards their antero-dorsal extremities ; postero-laterally they do not overlap the lower edges of the carapace at the bases of the ambulatory limbs. Truncated posterior border produced, but not overlapping the curve of the abdomen from a strictly dorsal view ; its width equal to more than three-quarters of the interspace between the antero-lateral margins

of the carapace, and less than the interspace between the extremities of the eyes ; the lateral margins very sinuate.

Carapace almost completely covered with large whitish tubercles, otherwise smooth. These tubercles are thickest on the branchial regions, which are traversed on their sides by several shallow longitudinal furrows. On the cardiac region is a pair of prominent rounded excrescences, one on each side of the median line. Regional grooves well defined, those marking off the branchial regions deeply furrowed. Sub-hepatic regions visible from above. Each antero-lateral margin armed with several simple and bicuspid spinules. Immediately posterior on each side is a conspicuously granular ridge which extends backwards to the anterior portion of the branchial region, and forms a produced lateral edge to the hepatic region.

Eyes moderately large and globose, the space between their tips greater than the width of the produced hinder margin of the carapace, and one-

Fig. 4. *Mictyris platycheles* H. M. Edw. View of front and rostrum of an adult male from the Hawkesbury River, New South Wales. (Same specimen as figured on Plate X.)

third again as great as the space between the mid-branchial regions. Front almost vertical and turned slightly inwards at the tip, shallowly channelled on its upper half ; the sides converge to form an elongated and acute median extremity.

Outer maxillipeds large, their inner margins forming a produced edge which projects beyond the vertical of the front ; their greatest length is about one-third wider than the hepatic regions, and about one-quarter longer than the upper palm and movable finger of the hand. The length of the merus is one-third that of the naked surface of the ischium, which is almost covered with large granules similar to those on the carapace.

The first segment of the abdomen is narrower posteriorly than at its articulation with the posterior border of the carapace, the former being about only two-thirds that of the latter. The successive segments increase in breadth to the fourth ; the fifth is about as broad as the fourth, but not as long ; the sixth is narrower and shorter than the fifth, and is about two-

thirds the length of the seventh. This last is rounded, and one-third longer than the sixth.

Sternum covered with large tubercles along each side of the abdomen, and with two strong spines anteriorly, one on each side of the seventh segment of the abdomen.

Ischium of each cheliped with a large spine directed forwards. Lower outer margin of merus faintly furrowed transversely, otherwise almost smooth except for a few granules which occur near the dorsal and ventral edges; the former is clearly serrated. Wrist and outer surface of palm smooth to the touch, but covered with minute microscopic granules which are a little enlarged near the dorsal and ventral edges of the wrist. This last is finely serrated along portion of its dorsal margin and is microscopically furrowed transversely above the median line, which is defined by an obtuse microscopically granular ridge on the distal half of the joint. Microscopic indications of furrows are noticeable on the ventral half of the palm. The depth of the palm is almost equal to the length of its lower margin, and is more than three quarters the length of the immovable finger; the upper margin is smooth. A shallow groove extends along the upper surface of the palm, defined above by an obtuse, scarcely granular ridge; an oblique, finely granular ridge extends backwards and downwards across the palm from the base of the movable finger, and a similar ridge extends downwards and forwards to form a keel on the side of the immovable finger. A well defined granular ridge forms the lower outer margin of the palm and continues forwards to form the lower outer edge of the immovable finger; another less defined but similar ridge on the inner edge of the palm extends forwards to form the inner edge of the immovable finger, and defines the edge of a groove which runs along the mid-ventral surface of the finger. Movable finger distinctly shorter than the wrist; immovable one only two-thirds the length of the wrist. The movable finger has a groove along two thirds of its dorsal surface, which is defined by two low ridges, the outer of which is a little higher than the inner. Two other finely granular ridges run from the base of the movable finger and form two keels on portion of its outer surface. The fingers meet a little before their tips and the immovable one is slightly in advance of the movable one; the latter curves evenly inwards while the former is curved outwards towards its tip. The cutting edge of the movable finger is armed with a very large smooth tooth near its base, which overlaps the immovable one when the fingers are closed. Several strong serrations are present on the cutting edge of the movable finger near its base.

Ambulatory limbs short and thick. The meri are heavily granular above and below the median line, which is smooth except for some shallow transverse furrows; a serrated or granular ridge is present on the dorsal margin of each. Carpus of each limb granular except for that of the last pair, which is almost smooth; all are finely serrated on their upper margins. Propodus of each limb broad, flat and clothed with granules; the upper margins of the penultimate pair irregular. Dactyls smooth, broad, and deeply channelled on their upper surfaces; those of the two anterior pairs of about equal length, whilst those of the two hinder pairs

are shorter ; the last pair are more slender than the others and are turned upwards and outwards towards the tip. The merus of the third pair of limbs not as long as the first to fifth segments of the abdomen.

Described and figured from an adult male example from the Hawkesbury River, New South Wales, measuring 15.5 mm. between the front and the hinder margin of the carapace, and 12 mm. across the branchial regions. These dimensions represent the average size of the adult male examples examined.

Colour.—Adult male specimens freshly preserved in alcohol are dark slaty blue on the back, with the branchial regions and portion of the cardiac region brownish. Abdomen, sternum, and underside of limbs creamish. Outer maxillipeds and pterygostomial regions light slaty blue. Upper side of ambulatory limbs and chelipeds brownish yellow, with the whole of the carpal joints and portions of the others lightly tinged with mauve.

The females are lighter in colour on the back than the males, and the branchial regions and limbs are creamish yellow. When viewed under a binocular microscope the whole of the branchial regions, the upper sides of the limbs, and the outer maxillipeds are seen to be covered with minute dark spots ; in some paler examples these spots are to be seen over the whole of the carapace.

Occurrence and habits.—*M. platycheles* occurs on the same tidal flats as *M. longicarpus* in the New South Wales section of its range. It is, however, not so plentiful, and does not congregate to such a noticeable extent as the genotype. According to verbal report it is very numerous in certain localities on the north coast of Tasmania, which is no doubt the centre of its distribution.

Sexual dimorphism.—Several adult females in the series before me are considerably smaller than the males. They have the branchial regions much less swollen antero-dorsally, and the ambulatory limbs are not so sturdy in structure. The chelipeds are weaker, and the tooth on the cutting edge of the movable finger is almost obsolete, as is also the tooth on the ischium. No large spines are present on the anterior part of the sternum as in the male.

Variation.—The adults are consistent in character, except that in some of the males there is an extra smooth obtuse ridge situated between the two described as on the upper half of the palm, and the front is slightly broader and shorter in some examples. The juveniles differ from the adults only in the matter of development ; in the case of the juvenile males a noticeable feature is the absence in some instances of the spines which later develop on the sternum.

History and synonymy.—Geoffrey Smith in 1909 described a crab occurring on a sandy beach at Bridport, Tasmania, as " a little round bluish Crab (*Hymenosoma*), present in such swarms that the sand was absolutely riddled with their little round burrows, and they themselves

as they ran had the appearance of, and made almost as much noise as, a swarm of bees." There can be little doubt that this reference refers to *M. platycheles*. It is true that Miers records *M. longicarpus* from Tasmania, but I am of the opinion that the specimen or specimens he examined were either wrongly labelled or correctly referable to *M. platycheles*.

The name "*Myctiris subverrucatus*" was given by Adam White in 1847 to a specimen in the British Museum secured in Van Diemen's Land, now Tasmania, during the voyage of the "Beagle." No description has appeared to validate the name, and the *nomen nudum* has since been associated by Miers (1884 and 1886) with H. M. Edwards' *M. platycheles*, a species described in 1852 from material from Western Port, Victoria, obviously collected many years earlier by Quoy and Giamard during the voyage of the "Astrolabe."

Stimpson (1907), being uncertain whether his specimens of *M. platycheles* from Botany Bay, New South Wales were correctly referable to that species, suggested the provisional name *M. prostoma*. The specimens of *M. platycheles* from Botany Bay in the Australian Museum collection agree in all details with examples from Victoria. The uselessness of the name *M. prostoma* is therefore apparent, and it must be relegated to the synonymy of *M. platycheles*.

Localities.—*M. platycheles* has been recorded to date from.—Port Western, Victoria—type locality (H. M. Edw., Ortmann); Melbourne, Vic. (Thallwitz); Tasmania (White, A.—as "Van Diemen's Land," Haswell, Miers, Smith); Botany Bay, N. S. Wales (Stimpson, Miers, Whitelegge); Port Jackson, N.S.W. (Tozzetti, Stead); Broken Bay, N.S.W. (Miers).

There are specimens in the Australian Museum from.—

Tasmania; old collection (4 adult males and 1 adult female; all of small size).

Victoria; collected late F. E. Grant (1 adult male, and 1 half grown male).

Jervis Bay, N.S.W.; coll. T. Whitelegge, 1893 (4 adult males of small size, 1 juvenile male, and 1 ovigerous female).

Shellharbour, N.S.W.; coll. G. McAndrew, 1923 and 1924 (2 adult males).

Gunnamatta Bay, Port Hacking, N.S.W.; coll. T. Iredale, 3rd May, 1925 (3 adult males, and 1 adult female). This series contains the largest male examined, which is 14 mm. wide and 16 mm. long.

Botany Bay, N.S.W.; coll. G. P. Whitley, 9th July, 1922 (1 adult male).

Botany Bay, N.S.W.; Exch. British Museum—from "Challenger" collection (1 adult male).

Rose Bay, Port Jackson, N.S.W.; coll. A. R. McCulloch (1 female with soft shell).

Hawkesbury River, N.S.W.: old collection (6 adult males, 1 half grown and 1 juvenile females). This series includes the figured specimen.

Nelson Bay, Port Stephens, N.S.W.; coll. A. R. McCulloch, 22-24th September, 1919 (1 half grown and 1 juvenile males).

Fingals Bay, Port Stephens, N.S.W.; coll. A. Musgrave, 24th August, 1920 (1 ovigerous female).

Port Stephens, N.S.W.; coll. R. Etheridge, jnr. 1897 (1 half grown and 4 juvenile males, and 6 juvenile females).

Moreton Bay, Queensland; coll. J. D. Ogilby (7 adult males).

The following specimens were lent for examination by the South Australian Museum.—Victoria; old collection (1 adult male, and 1 ovigerous female). The female in this series is the largest examined, and measures 12.5 mm. across the branchial regions and 13.5 mm. from the front to the hinder margin of the carapace.

Distribution.—Tasmania (north), Victoria, and thence northwards along the eastern Australian coast to Moreton Bay, Queensland.

Key to the species of the genus *Mictyris*, Latr. (males only).

A. A large conspicuous tooth on the cutting edge of the movable finger, antero-lateral spines connected by ridges with the anterior branchial regions.

B. Posterior border of carapace conspicuously produced beyond the curve of the abdomen; appearing smooth, and covered with only minute microscopic granules.. *longicarpus*, Latr.

C. Posterior border of carapace not conspicuously produced; median area with groups of granules, and branchial regions covered with granular ridges or rugae. .... *longicarpus*, var. *brevidactylus*, Stimp.

BB. Posterior border of carapace conspicuously produced, but not overlapping the curve of the abdomen from a strictly dorsal view; median area, branchial regions and outer maxillipeds covered with large whitish tubercles............................ . ... *platycheles*, H. M. Edw.

AA. An almost obsolete tooth on the cutting edge of the movable finger; anterolateral spines not connected by ridges with the anterior branchial regions. *livingstonei*, sp. nov.

The Status and Synonymy of the genus Megametope, and its Contained Species.

I am indebted to my late esteemed colleague, Allan Riverstone McCulloch—to whose interest and ever friendly encouragement I owe much—for his indispensable aid in elucidating the complex problems presented by this genus.

MEGAMETOPE (*H. M. Edw.*) *Filhol.*

Megametope (H. M. Edw.) Filhol, Miss. l'Ile Campbell, 1886, p. 373 (*rotundifrons*, H. M. Edw.).

Gabrielia McCulloch, Rec. Austr. Mus., vii, 1, 1908, p. 54 (*haswelli* Fult. & Grant = *punctatus* Haswell).

Megametope McCulloch, Rec. Austr. Mus., ix, 3, 1913, p. 326.

Status.—The name *Megametope* was first published by Filhol, who discovered it in the Paris Museum on the label of a specimen originally described by H. Milne-Edwards as *Xantho rotundifrons*. Although Filhol figured that species, he gave neither generic nor specific sharacters in the text relating to it. The fact that the name *Megametope* was published by Filhol in association with a species previously described by H. Milne-Edwards, however, entitles it to recognition.

Synonymy.—The name *Gabrielia* was proposed by McCulloch for a genus to accommodate several species from south-eastern Australia, which had been erroneously relegated to the genera *Cycloxanthus* and *Lioxantho*, with which they have no real affinity. It was properly defined, but the selection of *haswelli*, Fulton and Grant, as the genotype was somewhat unfortunate, because the identity of that species is debatable. McCulloch believed *haswelli* to be a valid species, but, as shown below, the name is properly referable to *M. punctatus* (Haswell). The identity of *Gabrielia* and *Megametope* was recognised by McCulloch in 1913, when he relegated his genus to the synonymy of that of Filhol (ex H. Milne Edwards' MS).

MEGAMETOPE PUNCTATUS *Haswell.*

Cycloxanthus punctatus Haswell, Proc. Linn. Soc. N.S. Wales, vi, 1882, p. 752; and Cat. Austr. Crust., 1882, p. 50.

Cycloxanthus ? punctatus vel *Lioxantho haswelli* Fulton and Grant, Proc. Roy. Soc. Vict. (n.s.), xix, 1906, p. 6-7 (part—name and references only).

Gabrielia punctata McCulloch, Rec. Austr. Mus., vii, 1, 1908, p. 56, pl. xii, fig. 4.

Generic position.—This species was referred to the genus *Cycloxanthus* by Haswell, and, in confusion with an allied species (= *rotundifrons*), to *Lioxantho* by Fulton and Grant, but it has not the characters of either of those two genera. McCulloch established *Gabrielia* for its reception together with two allied species, but that genus proves to be synonymous with the older *Megametope* from New Zealand.

Synonymy.—When referring this species to *Lioxantho*, Fulton and Grant noted that another species named *punctatus* was included in that genus. They therefore proposed the name *haswelli* as a substitute for

Haswell's species from New South Wales. At the same time they unfortunately confused with it an allied but distinct species (= *rotundifrons*) from Victoria which they figured, and this was later redescribed and figured by McCulloch as *Gabrielia haswelli*. The name *haswelli* was definitely proposed as a substitute for *punctatus* Haswell, however, and because that name proves to be valid, their *haswelli* must be relegated to the synonymy of *punctatus*.

Distribution.—This species was originally described from a single specimen from the estuary of the Parramatta River, Port Jackson, New South Wales (holotype in the collection of the Macleay Museum, University of Sydney). The only three other known examples of the species are in the Australian Museum collection. These were secured from Coogee and Long Reef, near Port Jackson, New South Wales, and from Shellharbour, south coast of New South Wales.

MEGAMETOPE ROTUNDIFRONS (*H. Milne Edwards*).

Xantho rotundifrons H. Milne Edwards, Hist. Nat. Crust., i, 1834, p. 397.

Megametope rotundifrons Filhol, Miss. l'Ile Campbell, 1886, p. 373, pl. xliv, fig. 3.

Cycloxanthus ? punctatus vel *Lioxantho haswelli* Fulton and Grant, Proc. Roy. Soc. Vict. (n.s.), xix, 1906, p. 6-7, pl. iii (part—figure and locality only).

Lioxantho haswelli Fulton and Grant, Proc. Roy. Soc. Vict. (n.s.), xix, 1906, p. 17.

Cycloxanthus ? punctatus Baker, Trans. Roy. Soc. S. Austr., xxxi, 1907, p. 175.

Gabrielia haswelli McCulloch, Rec. Austr. Mus., vii, 1, 1908, p. 54, pl. xii, figs. 5-5a.

Megametope rotundifrons McCulloch, Rec. Austr. Mus., ix, 3, 1913, p. 326.

Generic position.—Confusing Victorian specimens with the New South Wales species *punctatus*, Fulton and Grant referred them to the genus *Lioxantho*, but they do not have the characters of that genus. McCulloch included the Victorian specimens in his genus *Gabrielia*, which is shown above to be synonymous with *Megametope*.

Synonymy.—Fulton and Grant incorrectly identified Victorian specimens as *Cycloxanthus punctatus* Haswell, and for reasons quoted under the foregoing notes upon that species, established an alternative name, *Lioxantho haswelli*. As also is shown above, neither of these names are available for the Victorian species, but being unaware of that fact, McCulloch redescribed and figured it as *Gabrielia haswelli*. He later recognised

the similarity of his specimens to *Megametope rotundifrons* as figured by Filhol, and suggested their identity with that species. As I believe this last conclusion to be correct, I here quote the Victorian species under Filhol's name.

Distribution.—*M. rotundifrons* is known so far only from Cook Strait and Foveaux Strait, New Zealand, and Western Port and Port Phillip, Victoria. In the Australian Museum collection there are three specimens from Western Port, Victoria, and two specimens from Port Phillip, Victoria, one of which is a cotype of Fulton and Grant's *Lioxantho haswelli* (see footnote).

MEGAMETOPE CARINATA *Baker*.

Cycloxanthus ? carinatus Baker, Trans. Roy. Soc. S. Austr., xxxi, 1907, p. 173, pl. xxxiii, fig. 1.

Gabrielia carinata McCulloch, Rec. Austr. Mus., vii, 1, 1908, p. 57.

Distribution.—Previously recorded only from Port Willunga and Port Lincoln, South Australia. There is another specimen in the Australian Museum collection from King George's Sound, S. West Australia.

The species here called *Megametope rotundifrons* must not be confused with *Heterozius rotundifrons* A. M. Edwards, both of which species were described and figured together by Filhol from Cook Strait and Foveaux Strait, New Zealand. Filhol's notes upon them are so arranged as to lead easily to confusion, which probably accounts for the fact that *Megametope rotundifrons* has been omitted from Hutton's Index Fauna Novae Zelandiae and other papers on New Zealand crustaceans. Filhol states definitely that both species were collected by him in New Zealand waters, and several specimens of *Heterozius* collected by him at Cook Strait are in the Australian Museum, which were acquired by exchange with the Paris Museum. In addition to these there are two other specimens in the Australian Museum collection from Island Bay, Wellington, N. Zealand, collected by C. Hedley, 1915.

Key to the species of *Megametope*.—

A. Antero-lateral margins of carapace thickened, front markedly bent downwards.
  B. Outer surfaces of wrists and palms smooth............................. ...*rotundifrons*.
  BB. Outer surfaces of wrists and palms sculptured............................*punctatus*.
AA. Antero-lateral margins thin and cristate; front nearly horizontal.......*carinata*.

CONTRIBUTIONS TO THE CRANIAL OSTEOLOGY OF THE FISHES.*

No. II.

The Maxillae in the Eels and the Identification of these Bones in the Fishes Generally.

By

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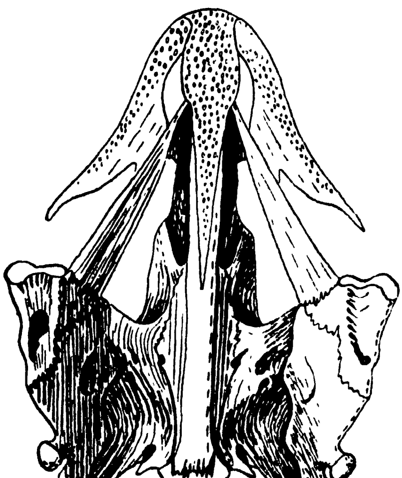
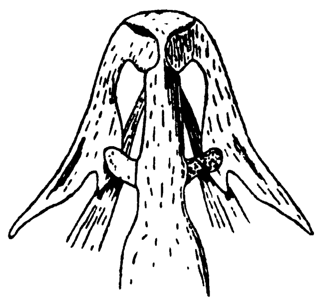
Honorary Zoologist

(Figures 1-8.)

The apode fishes present us with a palate and upper jaw which is of exceeding interest when interpreted aright. The number of bones in the jaw and palatal arch is reduced to four, including the quadrate and hyomandibular, on each side. Of these, the last two are identifiable at sight (Figures 1 and 2).





Figs. 1. and 2. *Anguilla.*

C. Tate Regan, in a paper[1] on the osteology and classification of the Apodes, thus describes the bones we are interested in " Præmaxillaries not developed as distinct elements; maxillaries bordering the mouth, separated anteriorly by the ethmoid; hyo-palatine bones reduced to 2 or

*For No. 2 see "Records" vol. xiv, no. 4, p. 271.

[1]Tate Regan—Ann. Mag. Nat. Hist., (8), x, 1912, p. 378.

3, hyomandibular, quadrate and palatopterygoid, the last sometimes absent."

The quadrate and hyomandibular being identified we are left with two bones in front of these, instead of the six usually present in this situation in other fishes. Of the teeth-bearing bones situated on either side of the ethmoid and bounding the gape, Boulenger[2] wrote, "Cuvier regarded the lateral bones of the upper jaw as præmaxillaries, Owen and Richardson as palatines (at least in Muraenas), whilst Peters and most recent authors have identified them throughout the order as maxillaries." Gill[3] in a series of papers dealing with the osteological characteristics of the families of the Apodes consistently designates them maxillaries. Continuing, Boulenger wrote[4] "The conclusion I have come to from the examination of numerous skulls belonging to various genera, is that the præmaxillaries have disappeared in all, whilst the maxillaries have persisted in the true eels (Anguillidae) and disappeared in the Muraenidae, their place being taken by the fused palato-ectopterygoids, which may even join the mandibular suspensorium. The vestigial bone, regarded by Jacoby as the pterygoid in *Muraena helena*, may be identified as the metapterygoid, and therefore does not disprove the homology, here suggested, of the other elements of the palate." This conclusion is quite unsupported by any illustrations or further discussion. The brief descriptions given by Gill in the series of papers already quoted do not disclose any divergent features presented by the bone as it is found in the five families of the Apodes he describes, beyond slight differences in the relation of its forward end to the mesethmoid. Tate Regan[5] discusses Boulenger's conclusion in a foot-note. He states :—"I find that in all their relations these bones are the same in the Muraenidae as in the other families ; distally they are external to the mandibles ; moreover the true palatopterygoids are present in the usual place, but reduced to mere threads of bone."

From my own observations I am prepared to endorse Tate Regan's conclusion ; whatever be the true designation of this tooth-bearing bone it is the same bone throughout the Apodes.

Now as to their correct designation. It will be shown that they are correctly termed maxillae, and by that is meant that they are homologous with those bones which have in the past been termed palatines. Among past observers Owen and Richardson, *fide* Boulenger, alone were correct in the identification of these bones. To this conclusion I am led by the relation of the bones to the mesethmoid and their situation inside the lips. An examination of the head of any fish having the maxillary and premaxillary labial bones will reveal the fact that these two bones are situated in the substance of the lip. When the mouth is shut they fit one behind the other in folds of the lip, the mandibular teeth are in contact

[2]Boulenger—Cambridge Natural History (Fishes), 1904, p. 599.

[3]Gill—Proc. U.S. National Museum, xiii, 1890 (1891).

[4]Boulenger—Loc. cit. p. 600.

[5]Tate Regan—Loc. cit., p. 378.

with the maxillary teeth (i.e. those borne on the bones that have heretofore been termed vomer and palatine), and the labial bones and their teeth are lateral to and outside those of the mandible. When the mouth is opened these labial bones are pulled down and are found in the lips at the free edge of the cheek (Figure 3).

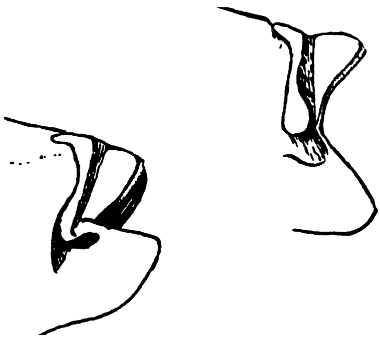


Fig. 3. *Girella tricuspidata*, Quoy and Gaimard. Showing the labial folds enclosing the labial bones. Mouth wide open and nearly shut.
The outlines of the bones accentuated.

Comparing now an eel head with such an one as above described, first with the mouth shut, it will be observed that full well developed lips are present in both, but that in the eel there is no fold formed by the overlapping of the labial bones; next with the mouth open, the teeth in the upper jaw are situated *within* the cheek and lips just as are those on the maxilla (palatine) of other fishes, and the teeth on the premaxilla (vomer) are bounded in front by a lip and buccal sulcus in the same manner as those on the premaxilla of other fishes are bounded in front, but that in these other fishes the lip has, imbedded in its substance, the premaxillary and maxillary labial bones. Now closing the jaws slowly, the two sets of teeth, upper and lower, will be found to come directly into contact.

The teeth-bearing bones of the eels are clearly not mobile labial bones; to that extent then they do not appear to be homologous with either of the labial bones.

Let us turn our attention next to the relation of these bones to the mesethmoid. The labial bones are attached by fibrous union in front of the mesethmoid and supported by a labial supporting spur of a bone which is firmly attached, at times sutured to the mesethmoid on either side just behind its fore end, and which itself bears teeth. The last portion of the last paragraph holds our attention at once. The bones we are discussing are firmly attached to the mesethmoid on either side just behind its fore end, and themselves bear teeth. The verity of this statement and actual identity of the maxilla of the eel with the so called palatines, true maxillae, of other fishes, become apparent when specimens

in which the maxillae and premaxillae are so closely related anteriorly as to present a continuous sweep around the front, *e.g.*, *Esox lucius*.

The labial bones are developed in membranous stroma, perhaps in relation to the evanescent labial cartilages in front of the mesethmoid. The maxilla is developed as an ossification of, or on the anterior end of the suborbital cartilaginous arch in close proximity to its attachment to the mesethmoid. If this tooth-bearing bone be not the maxilla then in the eels the suborbital arch has failed to develop a bone anteriorly, and a bone, developed in other teleosts anteriorly to the mesethmoid, has come to occupy its place. The development of the bones then, as known in other teleosts, supports the contention that this is the maxilla. In fact a critical survey of the bone in its relation to soft structures, to the other bones both of the upper and lower jaws, and the developmental evidence, discovers no single reason for the old identification of the bone as the maxillary labial. The designation palatopterygoid, applied to the remaining undetermined bone in the palate conveys nothing, except it be an expression of faith in its development from, or in relation to the palate quadrate cartilage; nowhere else in the vertebrate skull do we find a palatopterygoid bone. The term is either a confession of ignorance or a subterfuge. This bone can only be palatine or quadrato-jugal, there is no evidence of any fusion of bones here. Of these two bones the quadrato-jugal sometimes extends forward medial to the hinder end of the maxilla, but usually stops short when it reaches that bone. The palatine commonly extends far forward medial to the maxilla, sometimes actually finding attachment to the palatine plate of the premaxilla. It may be concluded that the so called palatopterygoid is really the palatine; there is no evidence to the contrary.

Let us now turn our attention to the broader question indicated in the title of this communication. In 1921[6] I postulated a fish jaw in which the labial bones were absent, supporting my postulate by reference to the fact that "in the muraenid eels maxillae and premaxillae are not developed," using those terms in the sense of their old application to the labial bones. When making that statement I assumed that Boulenger was right (*vide antea*). I had no suspicion that the tooth-bearing bone in the eels was in verity a maxilla as demonstrated above. Having now learned that the postulate was unnecessary, that the actuality might have been cited, it appears to me that the question of the serial homology of the piscine and tetrapod premaxillary and maxillary bones might again be profitably reviewed.

The raison d'etre of the old designation may be summed up very briefly. These two bones are the most anterior in the upper jaw, therefore they *must* be premaxilla and maxilla; that being so the more anterior must be premaxilla, the other the maxilla. There is absolutely no other evidence in support of this practice.

I have contended[7] that the labial bones of the bony fishes are homologous with the labial cartilages of the sharks and rays. In many of these

[6] Kesteven—Journ. Anat., lvi, 1922.

[7] Kesteven—*Loc. cit.*, p. 315.

forms the mouth is overhung by a hood which at first sight appears to be the lip. It is, however, lined both on the inside and on the outside by typical shagreened skin, and covers the true lip; this is lined on the outside like the hood but is lined on the inside by mucous membrane. Within the substance of the lip are the two labial cartilages one behind

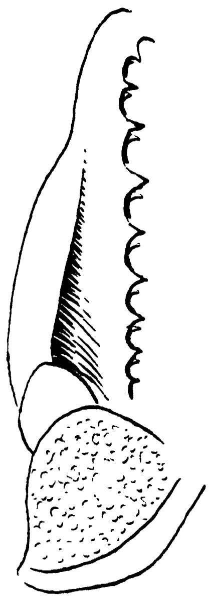


Fig. 4. *Squatina australis*. Half upper jaw from within showing buccal groove.

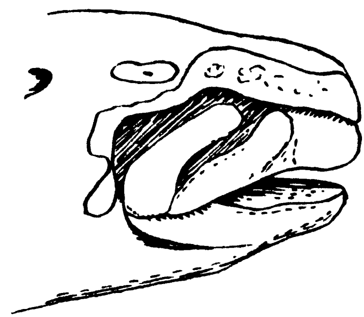


Fig. 5. *Squatina australis* from the side showing the folds enclosing the labial cartilages. The flap covering the mouth above has been cut away.

the other. The situation of these cartilages is best demonstrated in those elasmobranchs in which the mouth is terminal in front, as in the majority of the teleosts. The three drawings of *Squatina australis* show the situation of the true lip with its contained cartilages (Figs. 4, 5 and 6). In *Orectolobus maculatus* (Fig. 7) the cartilages lie in the lip, in very nearly the same situation as the labial bones in *Girella*; they do not, however, extend forward to meet in the mid line. Together they occupy a well formed lip, showing a sulcus between the cartilages and a deep furrow at their hinder end when the mouth is closed. When the mouth is opened the cartilages are drawn down and occupy the front border of the cheek, again as in *Girella* (Fig. 8); moreover the sulcus between the cartilages is shallowed considerably and the furrow behind almost completely abolished. There can be no question that the two, cartilages and bones, are labial structures, using that term here in a purely descriptive sense. Even so, the term is significant, labial structures are not used in mastication, neither are these. The labial bones are never used in mastication, that is performed between the teeth or plaques on the bones *within* the lips both of the upper and

lower jaws. The labial bones are prehensile devices, functionally they are not jaw bones.

Attention has already been directed to the fact that in *Polyodon* and in *Acipenser* the maxilla is developed in a manner completely different from that of the maxilla in other fishes.[8] In these forms it has developed

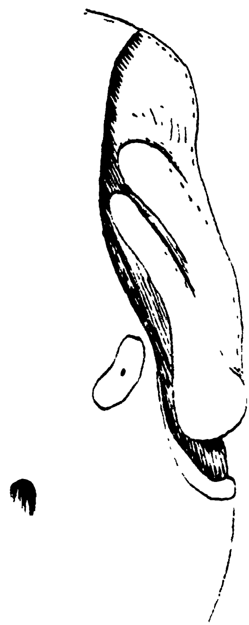


Fig. 6. *Squatina australis*. Half upper jaw from above showing the folds enclosing the labial cartilages.

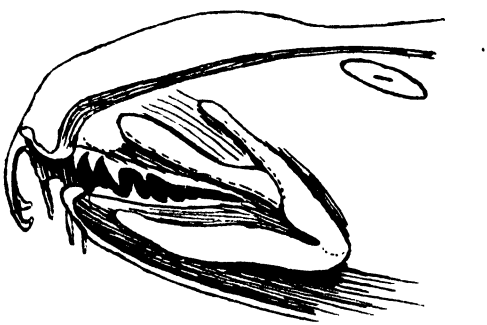


Fig. 7. *Orectolobus maculatus*, showing position of labial cartilages and labial furrow. Mouth closed.

[8] Kesteven—*Loc. cit.*, p. 314.

in relation to the palatopterygoid cartilage, in the majority of other fishes it is the so called palatine that develops in this situation. It is of significant interest to note that in these forms, as in the majority, if not all of the elasmobranchs, the palatopterygoid cartilages of either side meet in front, whereas in, I believe, all other teleosts, the palatopterygoid cartilages do not meet anteriorly but are attached on either side of the fore end of the ethmoid. There is every reason to believe that the bone is correctly named in the two ganoids, but if so then it cannot be in the forms in which the so called palatine develops in relation to the ethmoid and suborbital cartilaginous arch. It may be argued that

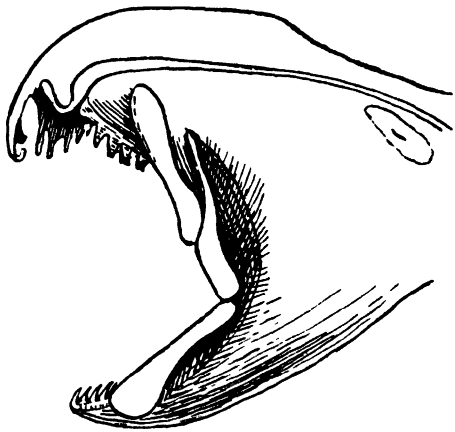


Fig. 8. *Orectolobus maculatus*, showing labial cartilages. Mouth open and labial furrows opened out.

my whole contention lacks force because in a very large proportion of the tetrapods the maxilla develops entirely independently of the subocular cartilaginous arch. On the other hand if my interpretation be correct, the true jaw bones developed first on the primitive cartilaginous masticatory framework ; later when that framework acquired an attachment to the axial craniovisceral skeleton anteriorly, the jaw bones acquired a new relationship to that later skeleton also, later still the greater part of the primary cartilaginous arch was dropped altogether, and the jaw bones retained their new relationship.

It is a fact that in certain of the teleosts the premaxilla is directly related to the forward end of the mesethmoid and the bone below it. Thus Huxley[9] describes the position in *Esox* " The anterior pair of preoral bones, small, and beset with teeth upon their under surface, are connected with the vomer and the termination of the cartilaginous rostrum formed by the internasal septum. They obviously answer to the human pre-

[9]Huxley—Elements of Comparative Anatomy, 1864.

maxillae." Before proceeding further it should be noted that *Esox* presents features in this respect which are to a large extent peculiar. Parker[10] has shown that in *Salmo* they are not developed in relation to either of the structures mentioned above, and Swinnerton[11] has given a like demonstration in *Gasterosteus*. Huxley's homology fails also by reason of the fact that the so called vomer is not the vomer of the higher vertebrates. Continuing Huxley wrote :—" An elongated bone, which bears no teeth, is connected anteriorly with the maxilla, and *lying external to the other bones, forms the boundary of the gape*. Its homology with the maxilla of man appears unquestionable." This homologisation rests upon the correct identification of the premaxilla, and the situation of the bones in the gape.

The table which follows is interesting ; it is based on the old designation of the preoral bones in the teleosts.

	Palato-pterygoid	Situation of Functional Jaw	Position of Maxilla and Premaxilla	Maxilla and Premaxilla Developed
Elasmobranchs	present	p.q.		
Polyodon and *Acipenser*	present	p.q.	on p.q.	on p.q.
Apodes	present?	p.q.?	on p.q.	on p.q.
Teleosts generally	present	p.q.	in front of p.q.	in front of p.q.
Amphibians	present	p.q.	on p.q.	on p.q.

As will be seen in this table the teleosts are quite unique in two respects if the old interpretation be adopted.

It is concluded that the old interpretation is not correct, and the terms premaxillary and maxillary labial are proposed for the two bones in the upper lip of the teleostean fishes which have heretofore been termed premaxilla and maxilla respectively.

It is further concluded that the true maxilla in the teleosts, homologous with that of the tetrapods, is the bone which has heretofore been designated palatine.

These conclusions are in conformity with those of a former contribution.

[10] Parker—Phil. Trans., clxiii, 1873 (1874), p. 95.

[11] Swinnerton—Q. Journ. Micro. Sci., xlv, 1902, p. 503.

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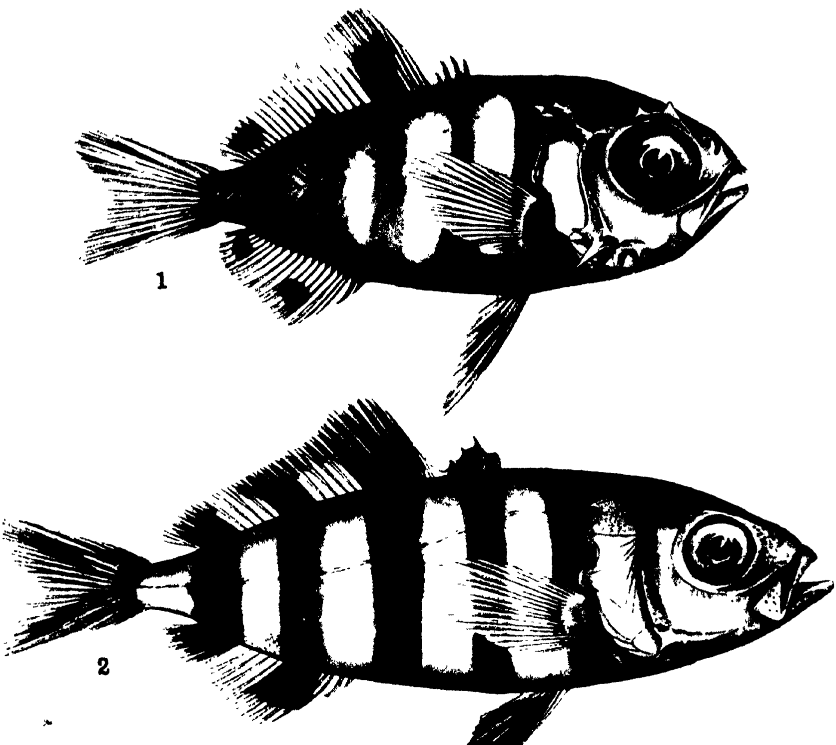
EXPLANATION OF PLATE I.

Naucrates ductor Linnaeus.

Fig. 1. A young specimen, 22.5 mm. long, from Shell Harbour, New South Wales.

„ 2. An older specimen, 42 mm. long, from Maroubra, New South Wales.



A. R. McCulloch, del.

EXPLANATION OF PLATE II.

Etched surface of the "Ticraco Creek" siderite, showing variation in Widmanstätten figures, and cylindrical inclusions of troilite. The characteristic "thumb-marks" and "drill-holes" are also shown.

EXPLANATION OF PLATE II.

Etched surface of the " Ticraco Creek " siderite, showing variation in Widmanstätten figures, and cylindrical inclusions of troilite. The characteristic " thumb-marks " and " drill-holes " are also shown.

G. C. CLUTTON, photo.

EXPLANATION OF PLATE III.

"Ticraco Creek" siderite showing the external characters and the hole through the middle.

G. C. CLUTTON, photo.

EXPLANATION OF PLATE IV.

"Ticraco Creek" siderite.

Fig. 1. End view, showing a "drill-hole" which has pierced the meteorite.

,, 2. A crystal of schreibersite included in troilite which is again partially surrounded by schreibersite.

,, 3. Portion showing the effect of weathering in bringing out the internal structure in relief.

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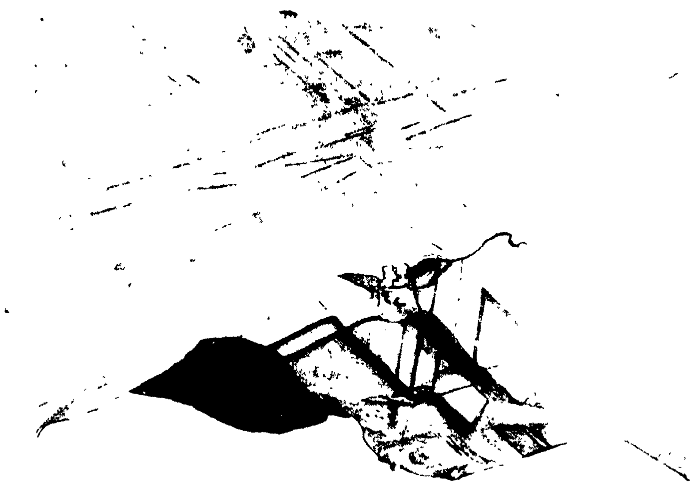


G. C. CLUTTON, photo. (1-2).
G. P. WHITLEY, del. (3).

EXPLANATION OF PLATE V.

Fig. 1. Zooecial detail of *Lepralia tuberculata* Philipps var. *avicularis* Livingstone. The large avicularia are depicted in some cases as being closed, and in others, open. The shallow avicularian cavities can be seen when the avicularium is open and are shown on the illustration by darkened areas very much like the avicularia themselves.

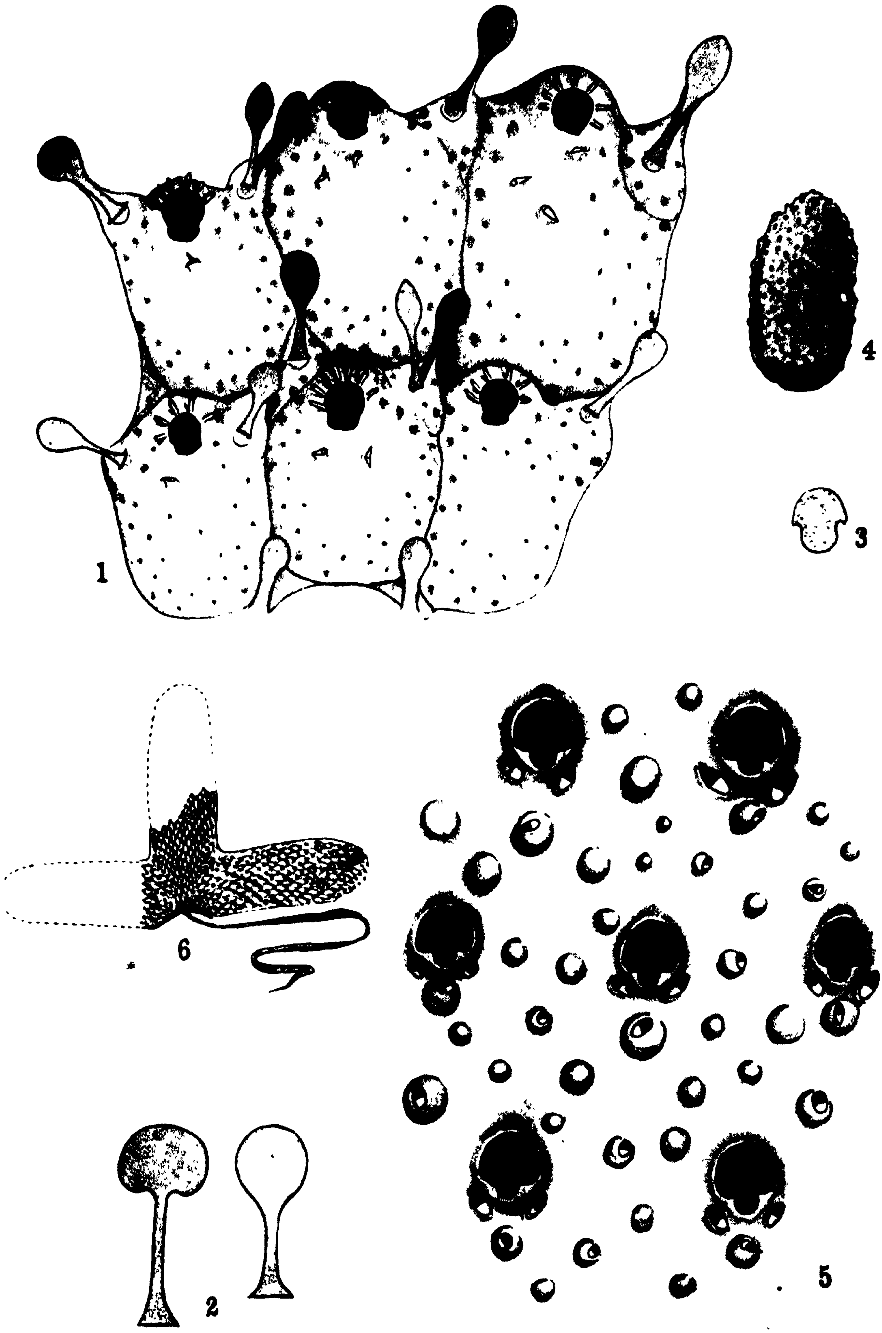
,, 2. Two differently shaped avicularia taken from a colony of *Lepralia tuberculata* Phillips var. *avicularis* Livingstone.

,, 3. Operculum of *Lepralia tuberculata* Phillipps var. *avicularia* Livingstone.

,, 4. Colony of *Bipora umbonata* Haswell. Drawn from a specimen from Holborn Island, 20 fathoms (type locality).

,, 5. Zooecial detail of *Bipora umbonata* Haswell.

,, 6. Portion of colony of *Parmularia quadlingi* Haswell with anchoring filament. The dotted continuation of the outline aims to illustrate what the colony would probably look like if complete.



G. P. WHITLEY, del.

EXPLANATION OF PLATE VI.

Fig. 1. Zooecial detail of *Parmularia quadlingi* Haswell showing ooecia and the peculiar avicularium in the zooecial aperture.

,, 2. Enlarged view of a zooecial aperture of *Parmularia quadlingi* Haswell in which there has been an avicularium.

,, 3. Enlarged view of the proximal portion of a zooecium of *Petralia vultur* Hincks var. *bennetti* Livingstone showing the aperture and associated characters.

,, 4. Zooecial detail of *Petralia vultur* Hincks var. *bennetti* Livingstone.

,, 5. Large zooecial avicularium of *Petralia vultur* Hincks var. *bennetti* Livingstone.

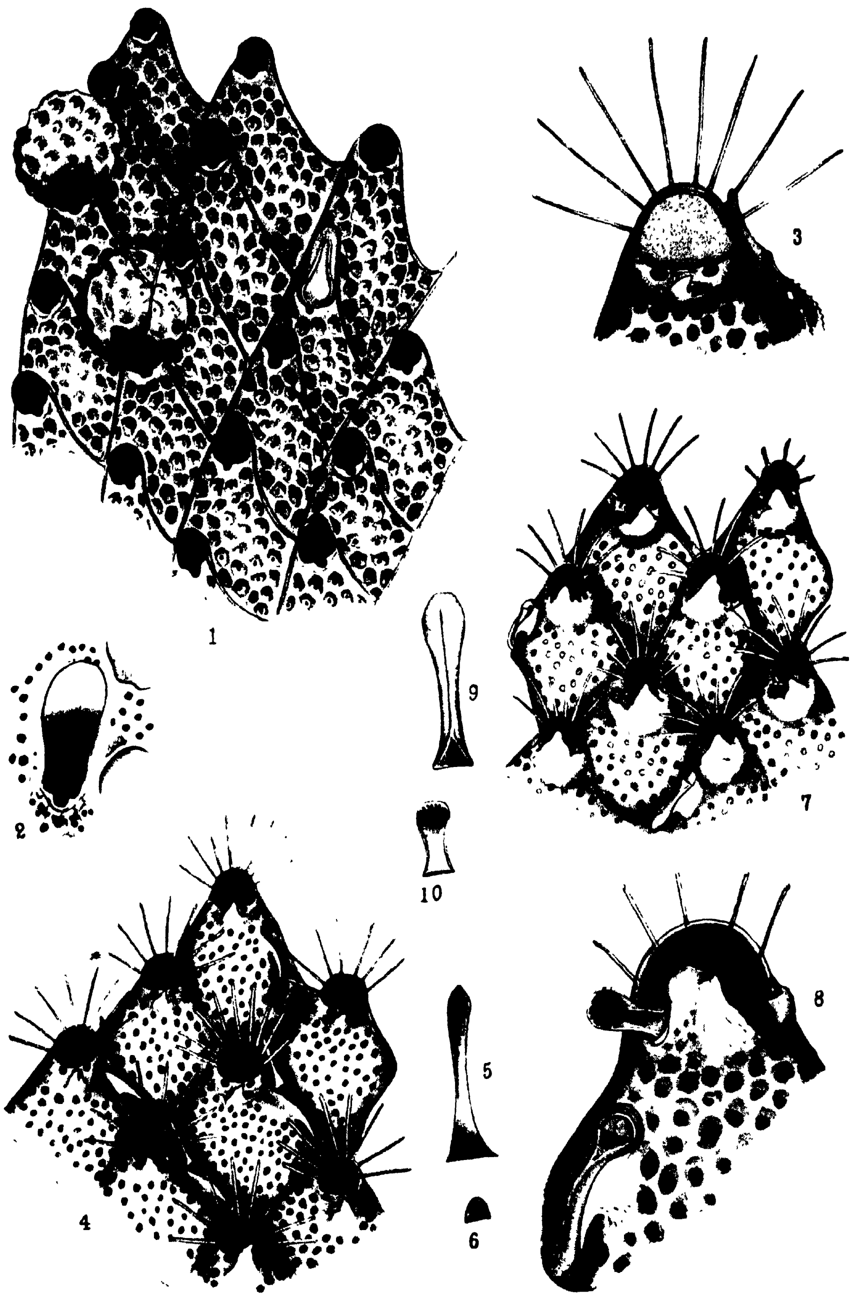
,, 6. Small avicularium from mucro of *Petralia vultur* Hincks var. *bennetti* Livingstone.

,, 7. Zooecial detail of *Petralia vultur* Hincks var. *serrata* Livingstone.

,, 8. Enlarged view of the proximal portion of a zooecium of *Petralia vultur* Hincks var. *serrata* Livingstone showing the aperture and associated characters.

,, 9. Large zooecial avicularium of *Petralia vultur* Hincks var. *serrata* Livingstone.

,, 10. Small avicularium from mucro of *Petralia vultur* Hincks var. *serrata* Livingstone.



G. P. WHITLEY, del.

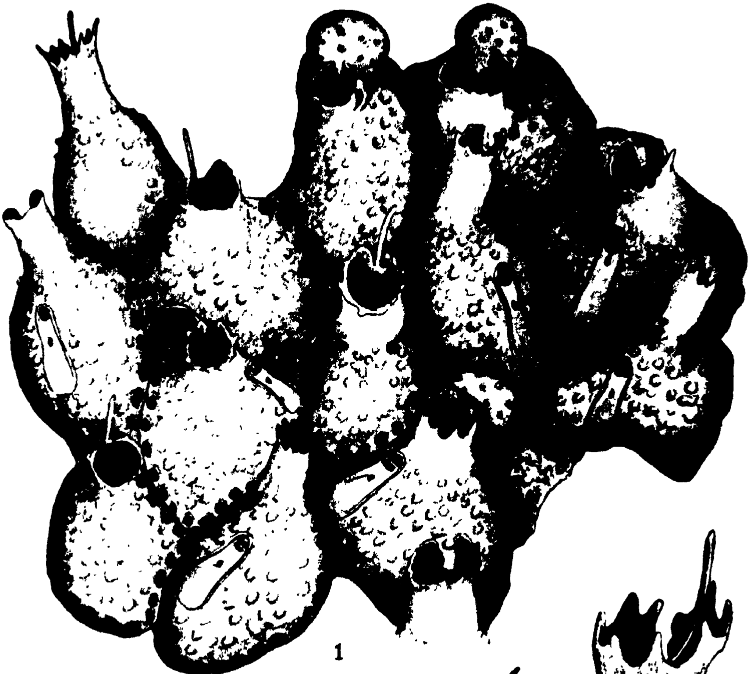
EXPLANATION OF PLATE VII.

(?*Phylactella*) *paradicei* Livingstone.

Fig. 1. Zooecial detail.

,, 2. Peristomial detail.

,, 3. Illustration of four zooecia which show the shape of the zooecial apertures and the denticles.



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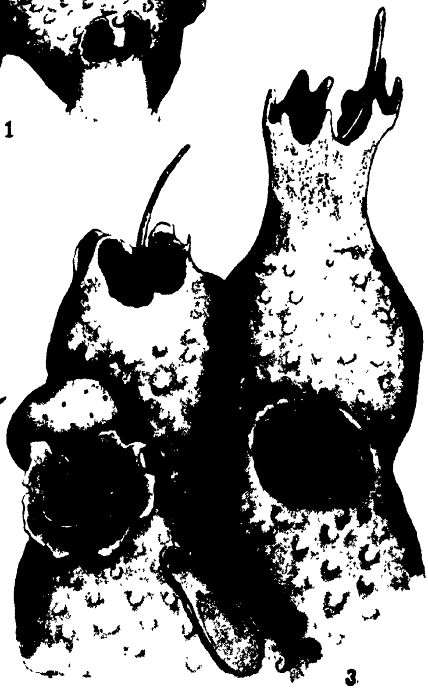

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G. P. WHITLEY, del.

EXPLANATION OF PLATE VIII.

Fig. 1. Zooecial detail of (?*Lepralia*) *porcellana* Busk var. *normani* Livingstone.

,, 2. Zooecial detail of *Porella areolata* Kirkpatrick.

,, 3. Operculum of *Porella areolata* Kirkpatrick.

,, 4. Large independent avicularium of *Porella areolata* Kirkpatrick.

,, 5. Zooecial detail of *Porella fissurata* Ortmann.

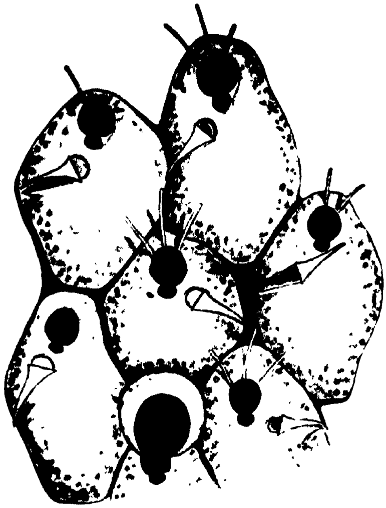
,, 6. Portion of a colony of *Porella fissurata* Ortmann showing how the large independent avicularia are grouped together in some places.

,, 7. Operculum of *Porella fissurata* Ortmann.

,, 8. Zooecial detail of *Schizoporella viridis* Thornely var. *thornelyi* Livingstone.

,, 9. Operculum of *Scaizoporella viridis* Thornely var. *thornelyi* Livingstone.

,, 10. Operculum of the typical *Schizoporella viridis* Thornely. Drawn from a specimen from Dauco Island, Great Barrier Reef near Port Moresby, New Guinea.



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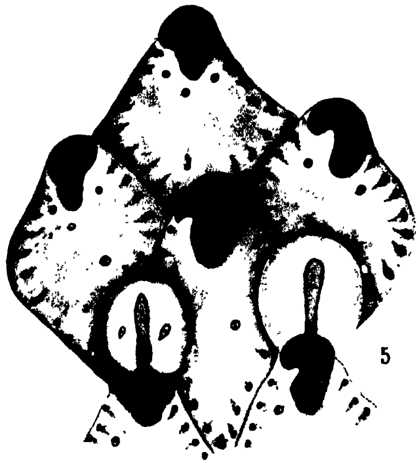

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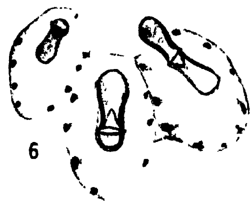

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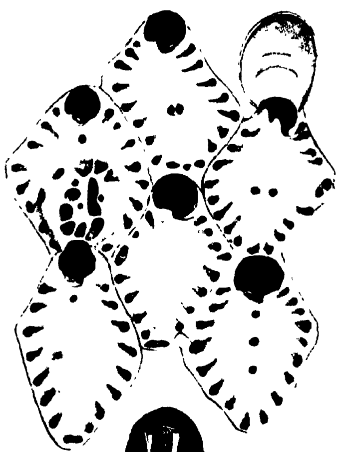

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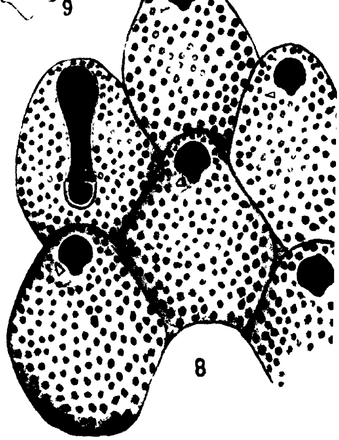

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G. P. WHITLEY, del.

EXPLANATION OF PLATE IX.

Mictyris longicarpus Latr.

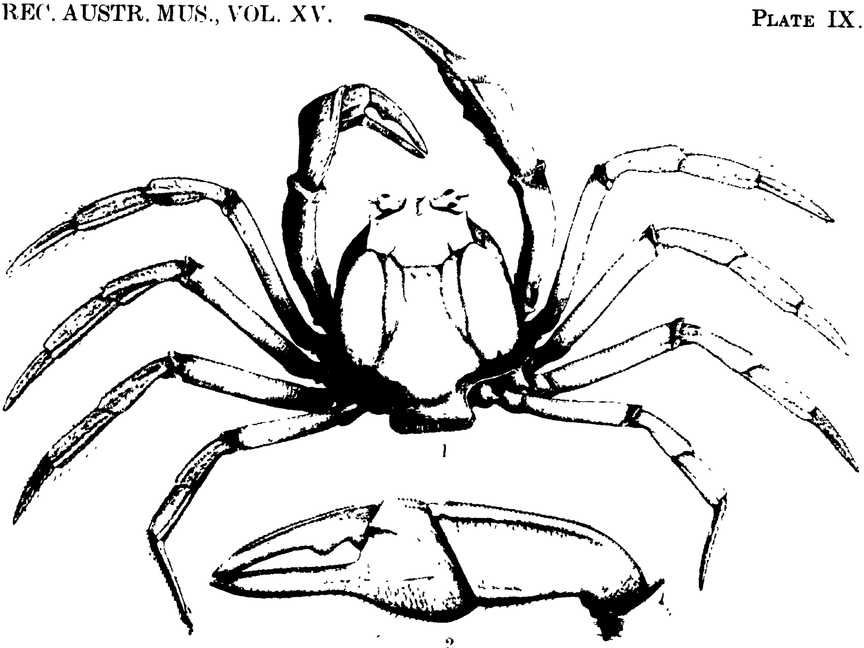
Fig. 1. Dorsal view of an adult male from Port Jackson, measuring 20.5 mm. across the branchial regions.

„ 2. Portion of left cheliped.

Mictyris longicarpus, var. *brevidactylus* Stimp.

Fig. 3. Dorsal view of an adult male from Subig Bay, Luzon, northern Philippines, measuring 11 mm. across the branchial regions.

„ 4. Portion of left cheliped.



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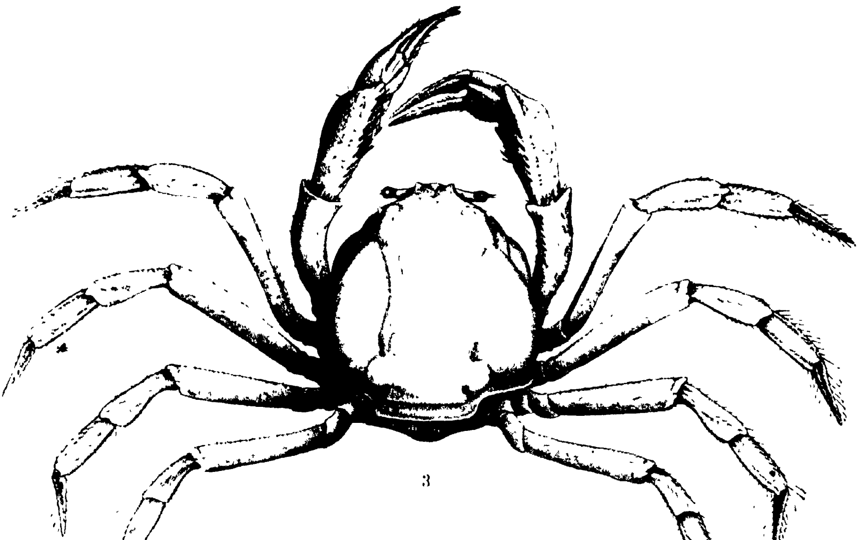

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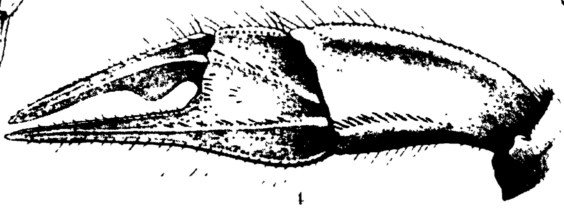

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F. A. McNeill and G. P. Whitley, del.

EXPLANATION OF PLATE X.

Mictyris livingstonei sp. nov.

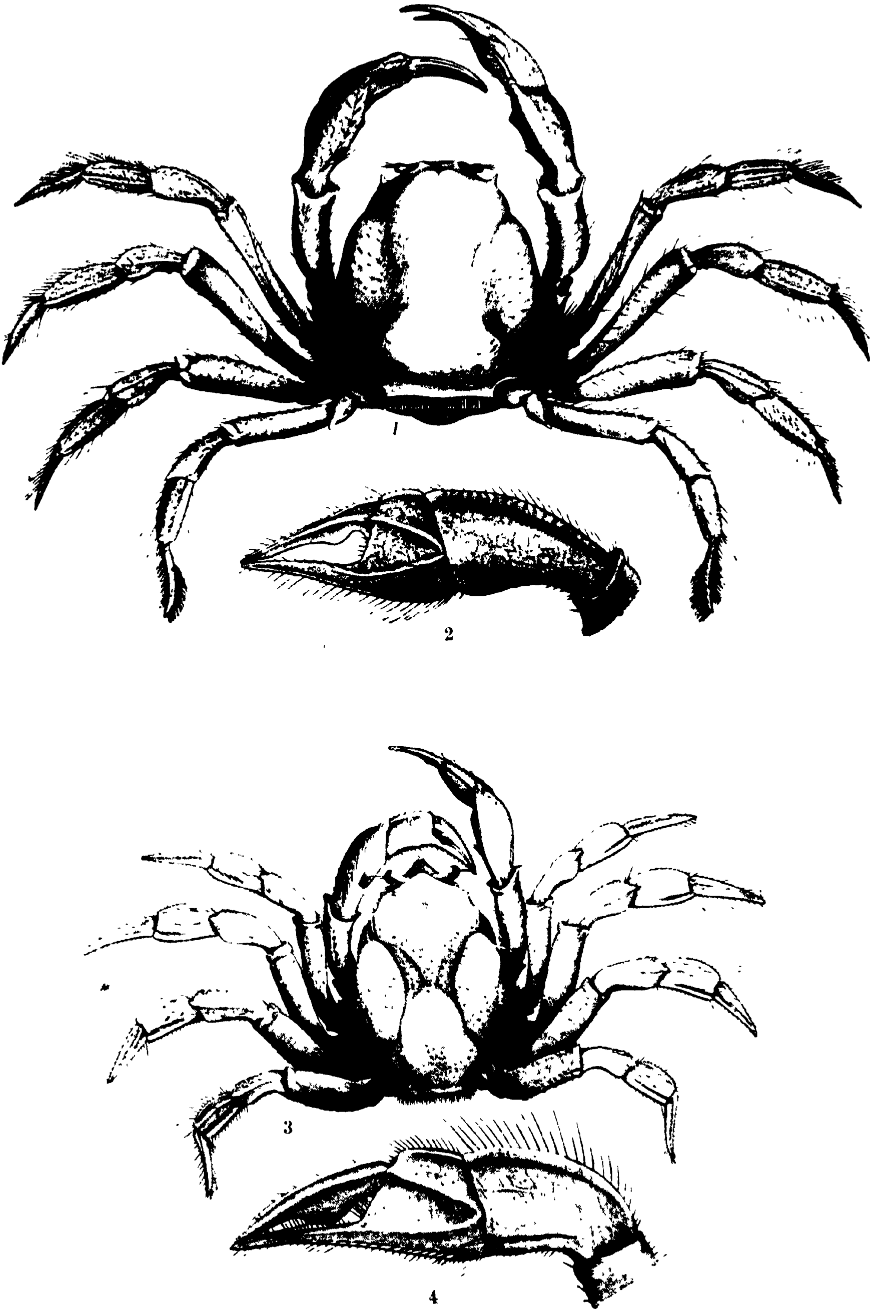
Fig. 1. Dorsal view of the male holotype, measuring 11 mm. across the branchial regions.

„ 2. Portion of left cheliped.

Mictyris platycheles H. M. Edwards.

Fig. 3. Dorsal view of an adult male from the Hawkesbury River, New South Wales, measuring 12 mm. across the branchial regions.

„ 4. Portion of left cheliped.



G. P. Whitley and F. A. McNeill, del.

ALLAN RIVERSTONE McCULLOCH.

FROM A RECENT PORTRAIT.

ALLAN RIVERSTONE McCULLOCH, 1885-1925.

By the death of A. R. McCulloch, which took place at Honolulu on September 1st, 1925, systematic ichthyology has lost one of its foremost exponents, and this Museum one of the finest officers it has ever had.

He was born at Sydney on June 20th, 1885, the son of Herbert Riverstone McCulloch and Ella Maud Backhouse, and at the early age of thirteen he became associated with the Australian Museum as an unpaid assistant to Mr. Edgar R. Waite, who was then in charge of the vertebrate section and is now Director of the South Australian Museum, Adelaide. Even in these early days young McCulloch was distinguished by his enthusiasm, his ability, and his determination to succeed in the sphere which he had entered. Assisted and encouraged by Mr. Waite, he made rapid progress both in the study of zoology and in the art of illustration, and when, in 1906, Waite became Curator of the Canterbury Museum New Zealand, McCulloch succeeded him as Assistant in Charge of Vertebrates, though he was not quite twenty-one. By that time he had definitely resolved to devote himself to the study of fishes and that became his life work, though he was skilled in all branches of zoology, and was recognised as an authority on decapod crustacea. He had a rare gift for taxonomic work, and, largely as a result of his numerous published papers, the taxonomy of Australian fishes has been placed on a sound basis.

His versatility was striking and in any work or hobby which he took up he was never satisfied with the second best. He was an expert photographer and cinematographer, an accomplished artist and musician, and a delightful lecturer. The various scenic and habitat groups recently installed in the Australian Museum were largely planned by him and owe much to his artistic taste and ability. He was a splendid organiser, and had taken a prominent part in training the younger members of the zoological staff of the Museum, most of whom had at one time or another served under him. His advice and assistance were often sought by other Australasian and foreign workers and he never failed to respond in a generous manner.

Although not of robust physique he was active and full of courage, and more than once he had risked his life in the pursuit of knowledge. He had made several trips to the Great Barrier Reef, usually in company with the late Mr. C. Hedley, and to various Pacific islands, had donned a diver's suit and descended into the dangerous waters of Torres Strait, and, in 1922, had, along with Captain Frank Hurley, undertaken an adventurous journey in Papua, from which he returned with many valuable specimens and a wealth of observations on the natives and the animal life of the island.

He was a great worker, and by his unremitting toil, often far into the night, he had seriously undermined his constitution. For two years his health had been in a very unsatisfactory state, and at the time of his lamented death he was on long leave of twelve months granted him by the Board of Trustees in the hope that his bodily and mental vigour

would be restored. After a short visit to Lord Howe Island he left Australia for Honolulu to attend the second Pan-Pacific Food Conservation Conference, in response to frequent invitations from Mr. A. H. Ford, Director of the Pan-Pacific Union, and all his friends hoped that the change would be beneficial to his health.

It is not surprising to find that with his unusual gifts he made a marked impression on the members of the Pan-Pacific Union during the few weeks he spent at Honolulu. The *Bulletin* of the Union for October, 1925, printed a short obituary and eulogy in which the following passages occur.

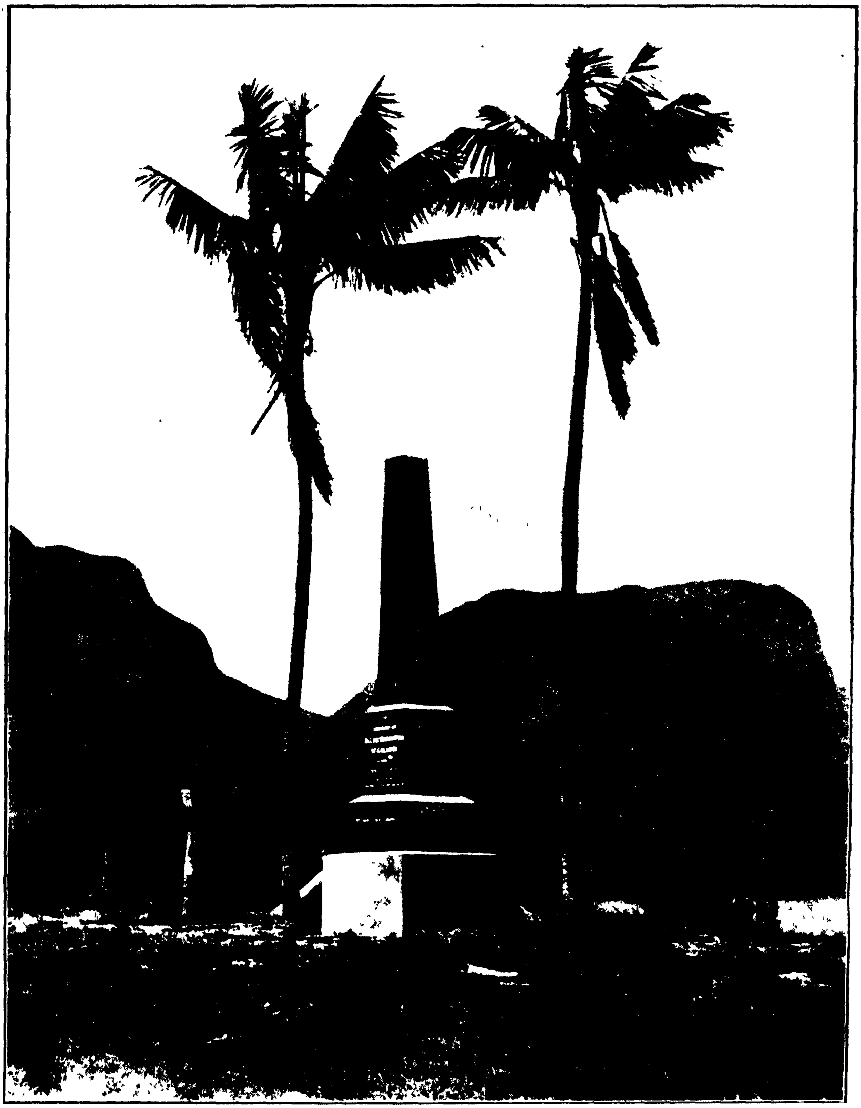
"In Allan Riverstone McCulloch, brilliant member of the staff of the Australian Museum, Sydney, . . . the Pan-Pacific Union loses a staunch friend and faithful worker.

"The Government of New South Wales had sent Mr. McCulloch to Honolulu to confer with Dr. David Starr Jordan, Dr. Barton Warren Evermann, and other fishery specialists from Pacific lands. Mr. McCulloch had been kept in constant cable communication with Dr. Jordan, who has stated that he was unquestionably the greatest authority on fish in the southern hemisphere, and one of the eight men in the world who really knew about fish. He had just finished a splendid piece of work in the form of an argument and agenda for the Pan-Pacific Fisheries Conference, in which among other things he advocated the establishment of a great biological university . . .

"During his stay of six weeks in Hawaii, Mr. McCulloch made many friends. He possessed an unusually pleasing personality, and because of his background as an explorer and scientist, scholar and gentleman, musician, artist, and lovable friend, was much sought after . . ."

It is obvious that although McCulloch was in a poor state of health during his stay in Hawaii, he devoted himself with his accustomed ardour to the work he found to his hand, thus still further reducing his already weakened frame until he broke under the strain. He paid the penalty of enthusiasm in his chosen field of research, in which he had become an acknowledged master, and we must regard him as a martyr in the cause of science.

When he died at the early age of forty he left a record of accomplishment rarely equalled in the full span of a human life. His work was marked by thoroughness and accuracy; he has been described by Dr. Jordan, one of the highest authorities, as "one of the most accurate workers in systematic ichthyology now living." Most of his contributions appeared in the *Records of the Australian Museum*, or in the official publications of other State museums, and were illustrated mainly by his own exquisite drawings in which he took great pride. He reported on the fishes collected by the Federal Trawler "Endeavour," one section, which he had completed just before he left Australia for Honolulu, being recently published. His most important work, which embodied the results of many years' toil and research, was his "Check-list of the Fishes and Fish-like Animals of New South Wales," published by the Royal Zoological Society of New South Wales (*Australian Zoologist* Vol. I, 1912, pp. 217-227; Vol II, 1921, pp. 24-68; 1922, pp. 83-130). This fine piece of work was issued separately as *Australian Zoological Handbook*,



"IN MEMORY OF
ALLAN RIVERSTONE McCULLOCH.
NATURALIST.
1885-1925.
ERECTED BY FRIENDS AND FELLOW WORKERS.
HIS ASHES REST HEREIN."

[Photo—*E. F. Pollock*

No. 1, in 1922 and forms an enduring monument to the industry and ability of the author.

His remains were cremated, and in accordance with the wishes of his relations and friends, his ashes were brought back to Sydney and subsequently conveyed to Lord Howe Island. On this beautiful little island, which McCulloch loved more than any other spot on earth, where he delighted to spend his vacations, and to the natural history of which he had devoted much study, a granite monument has been erected by his friends and scientific colleagues to perpetuate the memory of one of the most brilliant naturalists that Australia has produced.

C. ANDERSON.

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8. Studies in Australian Fishes. No. 2. *Rec. Austr. Museum*, vii, 4, 1909, pp. 315-321, pls. xc-xci, text-fig. 18.

1910.

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*Compiled from a MS. list of papers left by the late Allan R. McCulloch, revised and enlarged by Gilbert P. Whitley. The titles are arranged in chronological sequence; joint authorships are placed alphabetically under the second author's name, then in order of publication.

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23. Studies in Australian Fishes. No. 3. *Rec. Austr. Museum*, ix, 3, 1913, pp. 355-389, pls. xii-xx, text-figs. 54-55.
24. A Description and Figures of three Specimens of *Molacanthus* from the Central Pacific Ocean. *Proc. Linn. Soc. N.S. Wales*, xxxvii, 3, 1913, pp. 553-555, pls. lviii-lix.
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26. [Exhibition of drawings on special paper.] *Proc. Linn. Soc. N.S. Wales*, xxxviii, 2, 1913, p. 396.

1914.

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1916

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JAMES DOUGLAS OGILBY.

FROM A COMPARATIVELY RECENT PORTRAIT.

[Photo—*H. Hacker*

BIBLIOGRAPHY OF JAMES DOUGLAS OGILBY.

By Gilbert P. Whitley, Zoologist, Australian Museum.

James Douglas Ogilby was born at Belfast, Ireland, on 16th February, 1853, and died, after a long illness, in Brisbane, Queensland, on 11th August, 1925.

He was the son of William I. Ogilby, F.Z.S., the well known zoologist; his mother was a Douglas of the Earl of Morton's family. He was educated at Winchester College and Trinity College, Dublin. He had been a good athlete and had won many medals, chiefly for running. Several of his notes on mammals, birds, and fishes appeared in the "Zoologist" from 1874 to 1876. In 1883, he published an excellent catalogue of birds obtained by him in Texas, U.S.A., He was for some time employed at the British Museum and later, in 1885, became assistant in zoology at the Australian Museum. Here he wrote many papers on Australian fishes, some in conjunction with Dr. E. P. Ramsay. His Catalogue of Australian Mammals (1892) is still regarded as a very valuable piece of work. Ogilby's wife, an Irish lady, died in Sydney in 1894. There was no issue.

For some years he was Honorary Curator to the Museum of the Amateur Fishermen's Association of Queensland, by the members of which he is held in grateful remembrance. He was later appointed ichthyologist to the Queensland Museum, and wrote many fine papers on Queensland fishes.

Ogilby was for some years a Fellow of the Linnean Society of London. He was a respected friend of the late Allan R. McCulloch, and the two were regular correspondents. Professor David Starr Jordan knew Ogilby well and admired his work, which, "like that of McCulloch was of a very high order." The Amateur Fishermen's Association of Queensland has perpetuated his memory by erecting the "J. Douglas Ogilby Cottage" for the use of its members on Bribie Island, a popular fishing resort in Queensland.

(The above sketch of Ogilby's life has been drawn from information for which I am indebted to Mr. E. R. Waite, F.L.S., Director of the South Australian Museum, Mr. H. A. Longman, F.L.S., Director of the Queensland Museum, and Mr. Thomas Welsby of Brisbane. Obituary notices appeared in the Brisbane papers and in the Australian Museum Magazine, Vol. ii, No. 8, 1925, p. 267.

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143. Honorary Curator's Report. *Amat. Fisherm. Assoc. Qld. Ann. Rept.*, (1905-1906) 1906, pp. 8-14. [This and some subsequent Reports of the Honorary Curator of the Association's Museum (Mr. J. D. Ogilby) contain new fish records for Queensland, whilst some contain indications, without descriptions, of new genera and species.]
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164. Honorary Curator's Report. *Amat. Fisherm. Assoc. Qld. Ann. Rept.*, (1910-11) 1911, 4 pp.
165. On the Genus "*Gonorrhynchus*" (Gronovius). *Ann. Qld. Museum*, No. 10, 1911, pp. 30-35.
166. Descriptions of new or insufficiently described Fishes from Queensland waters. *Ann. Qld. Museum*, No. 10, 1911, pp. 36-58, pls. v-vi.
167. List of the Edible Fishes of Moreton Bay and its affluents. *Rept. Mar. Dept. Qld.* (1910-11) 1911, Appendix 7, pp. 15-16.
168. *Chelio inermis* (Forskal). *Ann. Qld. Museum*, No. 10, 1911, p. 183.
169. On some Queensland Fishes. *Mem. Qld. Museum*, i, 1912, pp. 26-65, pls. xii-xiv.
170. Honorary Curator's Report. *Amat. Fisherm. Assoc. Qld. Ann. Rept.*, (1911-12), 1912, 3 pp.
171. Note on *Blanchardia maculata*, Castelnau. *Mem. Qld. Museum*, i, 1912, p. 216.
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173. On six new or rare Queensland Fishes. *Mem. Qld. Museum*, ii, 1913, pp. 81-89, pls. xxi-xxiii.
174. Ichthyological Notes. *Mem. Qld. Museum*, ii, 1913, pp. 90-93.
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176. The Commercial Fishes and Fisheries of Queensland. An Essay. Brisbane, 1915, pp. 1-61.
177. Edible Fishes of Queensland. Part iii—Carangidæ (No. 1). *Mem. Qld. Museum*, iii, 1915, pp. 57-98, pls. xix-xxviii.
178. Review of the Queensland Pomacanthinæ. *Mem. Qld. Museum*, iii, 1915, pp. 99-116.
179. On some new or little-known Australian Fishes. *Mem. Qld. Museum*, iii, 1915, pp. 117-129, pls. xxix-xxx.
180. Ichthyological Notes (No. 2). *Mem. Qld. Museum*, iii, 1915, pp. 130-136.
181. Three undescribed Queensland Fishes. *Proc. Roy. Soc. Qld.*, xxviii, 1916, pp. 112-115.
182. Note on *Amia nigripes*, Ogilby. *Mem. Qld. Museum*, xxviii, 1916, p. 116.
183. Check-list of the Cephalochordates, Selachians, and Fishes of Queensland. *Mem. Qld. Museum*, v, 1916, pp. 70-98, 1 text fig.

184. A Revision of the Australian Therapons with Notes on some Papuan species. (With A. R. McCulloch.) *Mem. Qld. Museum*, v, 1916, pp. 99-126, pls. x-xiii, 1 text-fig.
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187. Ichthyological Notes (No. 3). *Mem. Qld. Museum*, v, 1916, pp. 181-185.
188. Edible Fishes of Queensland. Part x—Plesiopidæ (No. 1). Part xi—Lutianidæ (No. 1). Part xii—Nemipteridæ (No. 1). Part xiii—Sciaenidæ (No. 1). Part xiv—Balistidæ (No. 1). *Mem. Qld. Museum*, vi, 1918, pp. 45-90, pls. xvi-xxvi.
189. Ichthyological Notes (No. 4). *Mem. Qld. Museum*, vi, 1918, pp. 97-105.
190. Some Australian Fishes of the Family Gobiidæ. (With A. R. McCulloch.) *Rec. Austr. Museum*, xii, 10, 1919, pp. 193-291, pls. xxxi-xxxvii.
191. Alteration of Generic Name. *Proc. Roy. Soc. Qld.*, xxxi, 5, 1920, p. 45. [Author's separates issued 4th August, 1919.]
192 Edible Fishes of Queensland. Part xv—Serranidæ (No. 1). *Mem. Qld. Mus.*, vii, 1, 1920, pp. 1-30, pls. i-iii. [This paper includes a "List of the Opisthognathoid Fishes of the Indian and Western Pacific Oceans."]
193. Three new Queensland Fishes. *Mem. Qld. Museum*, vii, 4, 1922, pp. 301-304, pl. xix.

And numerous newspaper articles.

Ogilby also wrote a paper on fishes which was to have been published in the "Handbook of Sydney" for the use of the members of the Australasian Association for the Advancement of Science, printed in 1888, but his contribution did not appear, the reason being succinctly stated by the editor of that publication, William M. Hamlet, who wrote: "The reason may be asked why the birds and fishes have not been described; or why, at least, they were not mentioned? These creatures had a place in the list of contents; but like their living prototypes, which I fear are passing away, they have disappeared from my MS., and this through no fault of my own."

ON A COLLECTION OF PAPUAN DRAGONFLIES (*ODONATA*) MADE BY THE LATE MR. ALLAN R. McCULLOCH IN 1922-3, WITH DESCRIPTIONS OF NEW SPECIES.

BY R. J. TILLYARD, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.R.S., F.N.Z.Inst., F.L.S., F.G.S., F.E.S., C.M.Z.S.,

Chief of the Biological Department, Cawthron Institute, Nelson, N.Z.

(Figures 1-6.)

The collection of Dragonflies dealt with in this paper was made by the late Allan R. McCulloch of the Australian Museum, Sydney, during the period from November, 1922, to January, 1923, while exploring unknown regions of the central western part of Papua by boat and aeroplane, in company with Captain Frank Hurley. About one hundred and forty specimens are available for study; these were all originally in paper triangles, but many of the larger species have since been relaxed and set out on pins for the cabinet. An analysis of the Odonata collected shows that three families, eighteen genera and twenty-three species are represented, of which one genus and four species are new to science. Considering the grave difficulties attendant upon collecting in such a dangerous region, the result is a very good one, though it probably represents only a small fraction of the total Odonate fauna of the districts visited.

The specimens were taken in a number of localities, viz., Bramble Cay (Torres Strait), Goaribari Island, various parts of the Fly River, Herbert River, Aramia Lakes, and Lake Murray. Mr. McCulloch very kindly furnished me with some very interesting notes on the collection and the localities visited, from which I give herewith a number of extracts which may help us to visualize the conditions met with.

> "Ordinarily I could speedily have filled my collecting bottles, but was hampered with my rifle, and could not venture far from the other members of the party. One is apt to forget that one's head would be a prized trophy to any of the inhabitants of these parts (Lake Murray) and that even a jaunt in the dinghy is fraught with possible danger to the whole party. Hurley dislikes my venturing within "arrow-shot" of the banks, where I am tempted to chase the many and varied dragonflies which flit in such profusion around us."

The reference here is evidently to *Rhyothemis splendens* Sel., of which several are in the collection before me.

> "Nov. 14th, 1922. Herbert River. Dragonflies with partly iridescent blue-black and partly translucent wings were plentiful in the thick undergrowth of the scrub. They fly with a slow and fluttering flight and are easy to catch, but my net is constantly hooked up in the ever-present thorns of the lawyer vine."

> "Nov. 29th, 1922. Lake Murray. This lake is a large, swampy area in the centre of western Papua, which doubtless expands or contracts according to the amount of rain. It is drained by the short and winding Herbert River, which is a tributary of the Strickland; this again joins the Fly at Everill Junction. The lake is open but very shallow, being less than a fathom deep at the time of our visit.

...y deeper channels lead into two large arms, one winding away to the west and another to the north, and from each of these endless bays, inlets, and creeks extend away in every direction. The greater part of the banks is low and swampy, and either covered with grass or with a giant lotus whose wonderful pink and yellow flowers scented the air around the entrance to the lake. The heat was intense, and the water of the lake was always so heated that we dipped up water for a warm bath at the side of the ship. Dragonflies were more plentiful here than at any other place known to me, both as regards species and specimens. Nevertheless, I believe most of them occurred all along the Fly River right down to Mediri (about 60 miles from the mouth). At Mediri I failed to secure one species which I afterwards caught on Bramble Cay, whither it had been blown by the north-west wind."

"Dec. 15th to 21st, 1922. Bramble Cay, Torres Strait. This is a small sand-bank, two hundred yards in length, perched upon a reef, the northernmost of the Barrier Reef series. There is no fresh water and the rains of the heaviest storms disappear immediately through the coarse coral sand. The steady north-west winds which have prevailed during the last few days have driven a number of dragonflies of several species from the mainland of Papua to the island. I secured three species which I recognize as identical with those seen at Mediri."

"Dec. 26th, 1922. Aramia Lakes. These lie between the lower Fly River and the Bamu River; they are drained by the Aramia River, which wanders over an extraordinarily circuitous course to join the Bamu at Aramia Island."

"Jan. 8-11, 1923. Goaribari. This is an island at the head of the Gulf of Papua, off the mouth of the Omati River, and is nothing more than a mud-flat largely flooded at high tide, with a dense growth of mangroves."

With these vivid introductory word-pictures of the localities in our minds, we can now proceed to give a list of the species taken and to describe those which are new to science.

Order ODONATA (Dragonflies).

Suborder ZYGOPTERA (Damselflies).

Family COENAGRIIDAE.

1. TEINOBASIS RUFITHORAX (*Selys.*)

A single male, taken on Fairfax Island, Fly River, November 10th, 1922. The species is widespread in Papua and also occurs on the small islands in Torres Strait.

2. CERIAGRION ERUBESCENS *Selys.*

Four males and five females, taken in various localities:—Alligator Island, Fly River, one female, November 10th, 1922; near Everill Junction, one female, November 12th, two females, November 13th, 1922; Herbert River, three males, two females, November 14th, 1922; Mediri, one male, December 12th, 1922.

Three out of the four males have the end of the abdomen missing, but the fourth is complete and shows the anal appendages typical of this species, which appears to be widespread throughout Papua and Queensland.

3. Pseudagrion papuense *n. sp.*

(Figures 1, 2.)

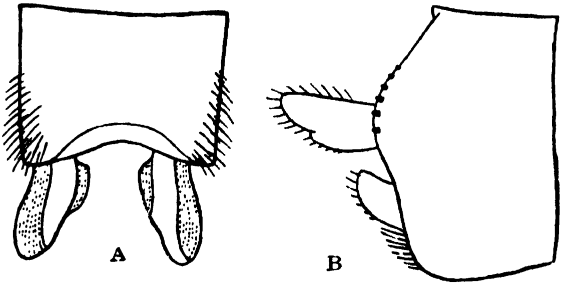

Fig. 1.

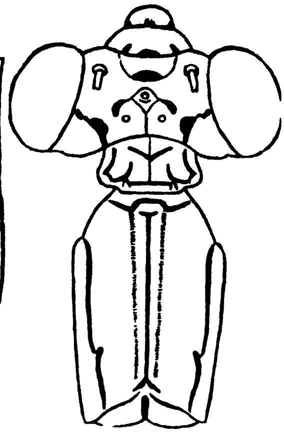

Fig. 1. *Pseudagrion papuense*, male, anal appendages. *a*, dorsal, *b*, lateral view.

Fig. 2. *Pseudagrion papuense*, female, head and thorax; to show colour-pattern.

Fig. 2.

♂ *Total length* 34, *abdomen* 28, *forewing* 19 mm.

Head blue, with black markings similar to those of the female, as shown in Figure 2; *labium* pale testaceous.

Thorax blue, marked with black as in the female (Figure 2). *Legs* livid grey, darker above.

Wings hyaline; *postnodals* 9-10 in forewings, 9 in hindwings; *pterostigma* trapezoidal, covering less than one cellule, brownish between black veins.

Abdomen blue; seg. 2 with a completely isolated trapezoidal black mark dorsally towards apex; segs. 3-7 with all dorsal part bronze-black except a narrow band at base and another at apex; the black part swells out laterally just before apex and is also slightly constricted in front of this swelling on each segment; segs. 8-10 entirely blue except for a crescentic blackish basal patch dorsally on seg. 10. *Appendages* (Figure 1):—*Superiors* about two thirds as long as seg. 10 viewed dorsally; blue bordered broadly on the outer side and narrowly on the inner side with black; in shape as shown in Figure 1, *not bifurcated at tips*, and only slightly notched when viewed from the side. *Inferiors* short, somewhat blunt, upturned.

Teneral male coloured like the young female.

♀ Resembles the male in size and markings, but differs from it in having the blue colouration replaced by yellowish testaceous, turning to a darker brownish when fully mature. The black markings of head and thorax are shown in Figure 2; the two stripes close to the mid-dorsal line on synthorax are brownish in the mature female, absent in the teneral form. The copulatory hooks on the prothorax, characteristic of the genus *Pseudagrion*, are very small, directed forwards, pale testaceous.

Seventeen males and three females, taken on Lake Murray, November 16th and 19th, 1922.

Slightly deeper channels lead into two large arms, one winding away to the west and another to the north, and from each of these endless bays, inlets, and creeks extend away in every direction. The greater part of the banks is low and swampy, and either covered with grass or with a giant lotus whose wonderful pink and yellow flowers scented the air around the entrance to the lake. The heat was intense, and the water of the lake was always so heated that we dipped up water for a warm bath at the side of the ship. Dragonflies were more plentiful here than at any other place known to me, both as regards species and specimens. Nevertheless, I believe most of them occurred all along the Fly River right down to Mediri (about 60 miles from the mouth). At Mediri I failed to secure one species which I afterwards caught on Bramble Cay, whither it had been blown by the north-west wind."

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Three out of the four males have the end of the abdomen missing, but the fourth is complete and shows the anal appendages typical of this species, which appears to be widespread throughout Papua and Queensland.

3. Pseudagrion papuense *n. sp.*

(Figures 1, 2.)

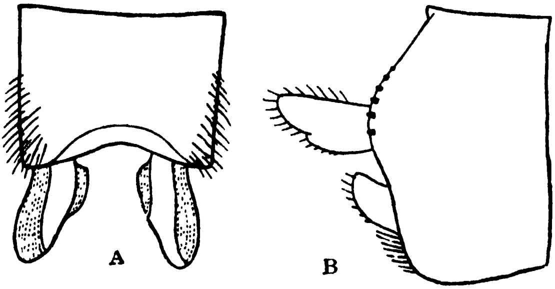

Fig. 1.

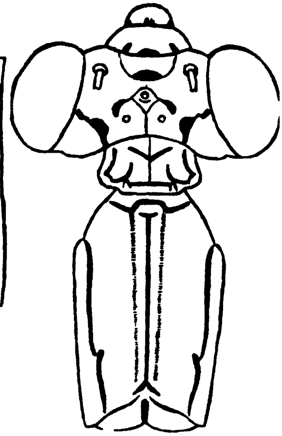

Fig. 1. *Pseudagrion papuense*, male, anal appendages. *a*, dorsal, *b*, lateral view.

Fig. 2. *Pseudagrion papuense*, female, head and thorax: to show colour-pattern.

Fig. 2.

♂ *Total length* 34, *abdomen* 28, *forewing* 19 mm.

Head blue, with black markings similar to those of the female, as shown in Figure 2; *labium* pale testaceous.

Thorax blue, marked with black as in the female (Figure 2). *Legs* livid grey, darker above.

Wings hyaline; *postnodals* 9-10 in forewings, 9 in hindwings; *pterostigma* trapezoidal, covering less than one cellule, brownish between black veins.

Abdomen blue; seg. 2 with a completely isolated trapezoidal black mark dorsally towards apex; segs. 3-7 with all dorsal part bronze-black except a narrow band at base and another at apex; the black part swells out laterally just before apex and is also slightly constricted in front of this swelling on each segment; segs. 8-10 entirely blue except for a crescentic blackish basal patch dorsally on seg. 10. *Appendages* (Figure 1):—*Superiors* about two thirds as long as seg. 10 viewed dorsally; blue bordered broadly on the outer side and narrowly on the inner side with black; in shape as shown in Figure 1, *not bifurcated at tips*, and only slightly notched when viewed from the side. *Inferiors* short, somewhat blunt, upturned.

Teneral male coloured like the young female.

♀ Resembles the male in size and markings, but differs from it in having the blue colouration replaced by yellowish testaceous, turning to a darker brownish when fully mature. The black markings of head and thorax are shown in Figure 2; the two stripes close to the mid-dorsal line on synthorax are brownish in the mature female, absent in the teneral form. The copulatory hooks on the prothorax, characteristic of the genus *Pseudagrion*, are very small, directed forwards, pale testaceous.

Seventeen males and three females, taken on Lake Murray, November 16th and 19th, 1922.

Types :—Holotype male (November 16th, 1922), specimen no. K. 52315; allotype female (November 19th, 1922), specimen no. K. 52326: and series of paratypes of both sexes in the Australian Museum Collection, Sydney, N.S.W.

At first sight this species appears to be identical with the very common *Ps. australasiae* Sel., the males being closely similar in their colour patterns. They differ, however, in having the black dorsal patch on seg. 2 completely isolated, and more especially in the form of the superior appendages, which are remarkable in not being bifurcated apically.

4. Ischnura torresiana *Tillyard.*

One female, November 16th, 1922, and a pair, November 19th, 1922, Lake Murray; one male, December 22nd, 1922, Aramia Lakes.

This species is the smaller and darker representative in Papua and North Queensland of the common Australian species *I. heterosticta* Burm.

5. Agriocnemis maccullochi *n. sp.*

(Figure 3.)

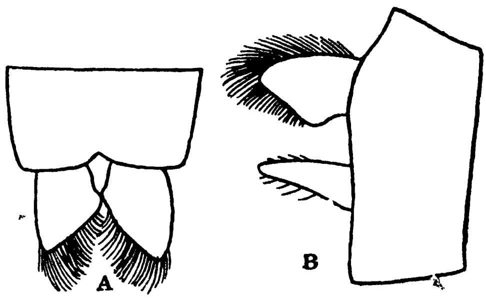

Fig. 3. *Agriocnemis maccullochi* n. sp., male, anal appendages. *a*, dorsal, *b*, lateral view.

♂ *Total length* 18.5, *abdomen* 14, *forewing* 9.5 mm.

Head :—*Epicranium* dull blackish, with bright metallic greenish reflections in places, especially behind the eyes, which are dark brown; *antennae* black, ringed basally with pale testaceous; *frons* black in middle, pale testaceous at sides: *postclypeus* steely black; *anteclypeus*, *labrum* and *genae* testaceous; *labium* pale testaceous.

Thorax bronze-black above, sides blackish with more or less whitish pruinescence, this latter being sometimes strongly marked also on anterior dorsal part of synthorax. *Legs* blackish, touched with pale testaceous on undersides of coxae, trochanters and bases of femora; hind tibiae with 5-6 long, slender bristles.

Wings hyaline; *postnodals* 7 in forewing, 5 in hindwing; *pterostigma* trapezoidal, with distal side longer than basal, covering less than one cellule; central area dull fuscous, surrounded by a paler marginal area and the whole enclosed by black veins.

Abdomen blackish above; genitalia of seg. 2, sides of segs. 3-10 and basal ring of segs. 3-7 all pale testaceous. *Appendages* :—*Superiors*

nearly as long as seg. 10, very hairy, shaped as in Figure 3, black above, the hairs testaceous; *inferiors* about as long as superiors, much slenderer and more pointed, only slightly hairy, testaceous inclining to fuscous. Seg. 10 raised apically and also markedly incised in the middle line dorsally.

♀ Unknown.

Four males (one teneral), Western Reach of Lake Murray, November 19th and 20th, 1922. Note by collector:—" Very hard to catch."

Types:—Holotype male (November 20th, 1922), specimen no. K. 52345; and paratype males, November 19th, 1922, in Australian Museum Collection, Sydney, N.S.W.

This species differs from all others of the genus except the Indian *A. lacteola* Sel. in having the labrum non-metallic. Most species of *Agriocnemis* are quite easy to catch, but the closely allied *Austrocnemis splendida* Martin is most difficult to secure, owing to its habit of sitting on the horizontally floating leaves of various water-plants, to which it clings tightly by means of its very long legs. The new species has its legs only moderately long and its venation is that of a typical *Agriocnemis*. It seems quite likely that it may have a somewhat similar habit of resting on floating leaves of aquatic plants, which would make it very difficult to capture. The species is dedicated to its captor, the late Mr. Allan R. McCulloch.

Suborder ANISOPTERA (Dragonflies).

Family CORDULIIDAE.

6. HEMICORDULIA SILVARUM *Ris*.

A very rare species, previously recorded only from South-west (Dutch) New Guinea. A single male, somewhat immature, is present in the collection, labelled " Papuan Gulf," without date. It is to be presumed that it flew on board the ship and was captured there.

Genus ANACORDULIA *n.g.*

(Figure 4.)

Closely allied to *Hemicordulia* and also to *Tetragoneuria*. It differs from the former in having the hindwing slightly angulated at the base in the male, and from the latter in the triangles of both wings being free and the anal loop of the hindwing blunter and ending somewhat further from margin, also in the inferior appendage of the male being about as long as the superiors. Post-trigonal space of both wings beginning with two rows of cellules. Subtriangle of forewing large, once-crossed. Anal loop of hindwing bluntly stocking-shaped, two cellules wide, and well-developed supplement, three cellules at distal end only, distal margin truncated obliquely to wing-margin below it. Two rows of cellules between anal loop and curved portion of posterior margin of hindwing. Anal triangle very narrow, with one short cross-vein; membranule bordering it for its whole length; anal angle projecting slightly beyond it. (Figure 4.)

Male with a well-developed keel on hind tibiae; fore tibiae without a

definite keel, but with a set of short, stiff, pectinately arranged setae ventrally on distal two-fifths, two series of long lateral bristles on basal

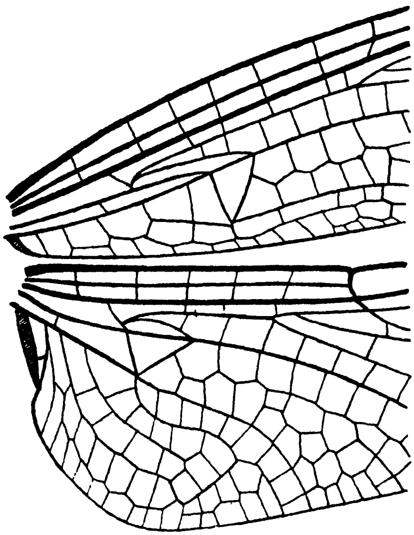

Fig. 4. *Anacordulia maccullochi* n.g. et sp., male. Basal third of fore and hind wings, to show venation.

three-fifths, and a series of finer long hairs from end to end. Abdomen rather narrow, shorter than wings.

Genotype :—*Anacordulia maccullochi n. sp.*

7. ANACORDULIA MACCULLOCHI *n. sp.*

(Figures 4, 5.)

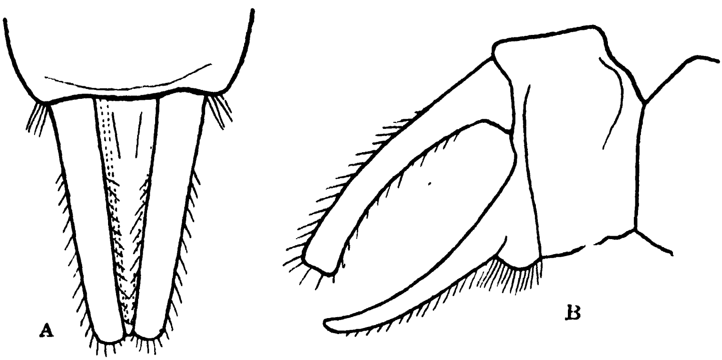

Fig. 5. *Anacordulia maccullochi* n.g. et sp., male, anal appendages. *a*, dorsal, *b*, lateral view.

♂ *Total length* 34.5 m.m., *abdomen* 22.5 mm., *forewing* 31 mm., *hindwing* 29 mm.

Head very wide (6 mm.). *Eyes* dark brown (probably green in life). *Vertex* rather large, strongly tuberculate, blackish; *middle ocellus* large and conspicuous, orange-brown, transparent. *Frons* very hairy, dark brown with steely reflections. *Clypeus* dark brown, shiny. *Labrum* chestnut brown with two black marks basally, one on either side of the middle line, confluent both basally and distally, isolating between them a small bright brown spot. *Labium* medium testaceous brown, hairy.

Thorax narrow (3 mm.). *Prothorax* dark brown above, medium brown on sides. *Synthorax* hairy above, dark brown with steely reflections on either side of mid-dorsal carina; on each side are two broad lateral bands of steely reflections, not sharply defined. *Legs* dark brown shading to blackish on hind femora. Fore tibiae with ten short, closely set distal setae forming a comb, five long setae in inner lateral basal row and seven in outer row. Hind tibiae with narrow keel extending its whole length, and two complete sets of lateral bristles.

Wings lightly tinted with brown all over, especially along the veins; base and costa from nodus to pterostigma slightly saffroned. *Antenodals* 7 in fore, 5 in hindwing, all complete. *Postnodals* 5-6 in fore, 7 in hindwing. *Pterostigma* 1.6 mm., not braced, covering less than the length of one cellule beneath it, very dark brown. *Oblique vein* second from subnodus in both wings. Forewings with four cellules before subtriangle in anal field. Hindwings with narrow anal triangle once-crossed.

Abdomen dull blackish, short, about three-fourths the length of hindwing; seg. 2 slightly swollen, seg. 3 slightly constricted, rest almost cylindrical. *Accessory genitalia of seg.* 2 large and prominent, the genital lobes large, very concave to the hamuli and forming a partial sheath for them covering their tips; each genital lobe ends in a sharp, downwardly directed process armed with stiff hairs; posterior hamuli convex, ridged and hairy externally. *Terminal appendages*:—*Superiors* 1.8 mm., dull black, straight, subcylindrical, converging apically when viewed from above (Figure 2 A); when viewed laterally, depressed, slightly curved, with truncate tips (Figure 2, *B*). *Inferior* about as long as superiors, sub triangular, concave above basally, distal portion strongly pointed, upcurved (Figure 2, *B*).

♀ Unknown.

Habitat.—Bramble Cay, Torres Strait, evidently blown by northwest wind from Fly River region, Papua. Mr. McCulloch probably refers to this species when he says that he saw at least one species which he secured at Bramble Cay which he could not catch in the swampy land around Mediri.

Type.—Holotype male, specimen no. K48426 in Australian Museum Collection, Sydney. This unique specimen is a fine discovery, and the species is dedicated to its captor, the late Allan R. McCulloch.

Family LIBELLULIDAE.

8. AGRIONOPTERA INSIGNIS ALLOGENES *Tillyard.*

One female, somewhat immature, from Goaribari Island, January 4th, 1923. The specimen agrees with Australian forms in having the triangles free and only one cross-vein in cubital space of hindwing. and hence belongs to the subspecies *allogenes* Tillyard.

9. ORTHETRUM VILLOSOVITTATUM VILLOSOVITTATUM *Brauer.*

One teneral female, Fairfax Island, Fly River, November 8th, 1922; one teneral male, Goaribari Island, January 4th, 1923; two teneral males, "Papuan Gulf," undated, presumably captured on board ship. Three specimens, one male and two females, taken at sea, about 20 miles south of Bell Point, Gulf of Papua, including a pair taken *in cop.* on the boat. This species is very common throughout Papua and Eastern Australia as far south as Sydney.

10. DIPLACODES TRIVIALIS *Fabricius.*

Four males (one teneral) and six females, Lake Murray, November 16th, 1922; a single male of exceptionally large size, Aramia Lakes, December 26th, 1922. A very common species in the tropics.

11. BRACHYDIPLAX DENTICAUDA *Brauer.*

= *B. australis* Kby.

Eight males and ten females from various localities, viz.:—Fairfax Island, Fly River, three males (two teneral), one teneral female, November 8th, 10th, 1922; Herbert River, two males, five females, November 14th, 1922; Samagi Village, Fly River, one teneral female, November 6th, 1922; Lake Murray, one female, November 16th, 1922; Sturt Island, Fly River, one male, one female, December 2nd, 1922; Adura Village, Fly River, one teneral female, December 5th, 1922; Bramble Cay, one male, December 18th, one female December 21st, 1922.

Evidently a very common species in this part of Papua; in North Queensland it is only moderately common.

12. NEUROTHEMIS DECORA *Brauer.*

One male, near Everill Junction, Fly River, November 12th, 1922; five males and one female, Herbert River, November 14th, 1922; one male, Lake Murray, November 16th, 1922. A very beautiful species.

13. NEUROTHEMIS STIGMATIZANS BRAMINA *Guérin-Méneville.*

One isochrome female, Herbert River, November 14th, 1922; three isochrome females, Western Reach, Lake Murray, November 19th, 1922; one male, fully mature, Bramble Cay, December 21st, 1922, with note on label "Same species seen at Mediri (Fly River)."

This Papuan subspecies is interesting in that the female has two distinct forms; the *isochrome*, in which the brown colouring of the wings is distributed on the same plan as in the male (but not extending as far as the pterostigma), and the *heterochrome*, in which the wings are quite differently coloured from those of the male. In the material before me. only isochrome females occur, and in all of them the brown colouration of the wings is followed distally by an opaque transverse band resembling that found on both sexes of *N. decora* Br. One of the females from Lake Murray also has the apices of all four wings brown; this is part of the colour-scheme of the heterochrome female, and appears to indicate that intermediate forms also exist. The Australian subspecies, *N. stigmatizans*

stigmatizans Fabr., common in North Queensland, possesses only heterochrome females with lightly shaded wings.

14. RHODOTHEMIS RUFA (*Rambur*).

One male, Fairfax Island, Fly River, November 8th, 1922.

15. HYDROBASILEUS BREVISTYLUS *Kirby*.

One male, one female, Aramia Lakes ; one male, taken at sea, about 20 miles south of Bell Point, Gulf of Papua (blown across by the north west wind).

16. TRAMEA LOEWI *Brauer*.

One male, one female, Bramble Cay, Torres Strait (blown across by the north west wind), December 21st, 1922.

17. PANTALA FLAVESCENS *Fabricius*.

One female, Bramble Cay, Torres Strait, (blown across by the north west wind), December 21st, 1922.

18. MACRODIPLAX CORA *Brauer*.

One mature male, Lake Murray, November 16th, 1922.

19. RHYOTHEMIS GRAPHIPTERA *Selys*.

One male, one female, Western Reach of Lake Murray, November 19th, 1922 ; three males, five females, Lake Murray, November 16th, 1922.

20. RHYOTHEMIS PHYLLIS CHLOE *Kirby*.

Three females, Samagi Village, Fly River, December 6th, 1922 ; two females, Mediri, Fly River, December 12th, 1922.

21. RHYOTHEMIS REGIA CHALCOPTILON *Brauer*.

One female, Lake Murray, November 22nd, 1922 ; one male, Samagi Village, December 6th, 1922 ; three males and two females, including a pair taken *in cop.*, Aramia Lakes, December 26th, 1922. The wings are not quite as black as in most Australian examples of this species.

22. RHYOTHEMIS RESPLENDENS *Selys*.

One male, Buceros Island, Fly River, November 9th, 1922 ; one male, Fairfax Island, Fly River, November 8th, 1922 ; one male, one female, Adura Village, Fly River, December 4th, 1922 ; two females, Samagi Village, Fly River, December 6th, 1922.

This is the most brilliantly coloured species of the genus, the brilliant metallic blue wings of the male being very striking, especially when displayed in full sunshine.

23. RHYOTHEMIS HURLEYI *n. sp.*

(Figure 6.)

♂ *Total length* 34 mm. ; *abdomen* 21 mm. ; *forewing* 38 mm. ; *hindwing* 36 mm.

Head.—Eyes dark brown. *Vertex* and most of *frons* deep metallic purple ; *clypeus* and lower lateral parts of *frons* shiny brownish ; *labrum* black ; *labium* rich brown.

Thorax blackish above with dense soft grey hairs ; sides dark brown with steely reflections. *Legs* black.

Wings of the general shape of those of *Rh. phyllis* Br., the hindwings very broad basally. Membrane for the most part hyaline, apices slightly suffused with brownish. Forewing with a very little dark brown at

extreme base; *pterostigma* 2.3 mm., dark brown, with two cross-veins below it, the first being slightly suffused with brownish on its distal side in right wing only. Hindwing with *pterostigma* slightly shorter and having the space below it dark brown from level of base of pterostigma to two-thirds of its length. Posterior margin at one-third from apex with a small blotch, metallic purple, irregular in shape, covering from two to four small cellules. Basal portion of hindwing from costa to posterior margin rich deep metallic purple, the boundary between this colour and the hyaline portion being irregular, as shown in Figure 3; on costa, the purple covers only the first two out of six antenodals, but lower down it expands

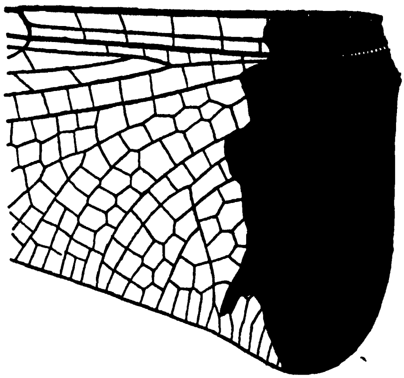

Fig. 6. *Rhyothemis hurleyi* n.sp., male. Hindwing from base to nodus, to show venation and colouring.

so as just to cover both triangle and supra-triangle, then cuts transversely across the post-trigonal space, then widens for another cellule and a half distad, and finally runs slightly obliquely and irregularly to a point on the posterior margin just distad of the main rounded curve of the anal part of the wing. Postrigonal space of hindwing beginning with two cellules, then widening to three rows. *Antenodals* of forewing 9-10, the last incomplete, of hindwing 6; *postnodals* of forewing 10-12, of hindwing 12-14.

♀ Unknown.

Habitat.—Lake Murray and Aramia Lakes, Papua.

Types.—Holotype male (Aramia Lakes, December 26th, 1922), specimen no. K48414, and two paratype males (Lake Murray, November 19th, 1922), in Australian Museum Collection; one paratype male (Lake Murray, November 19th, 1922) in Cawthron Institute Collection.

This magnificent species, which I dedicate to Captain Frank Hurley, leader of the expedition to Lake Murray, resembles *Rh. severini* Ris., most closely in its scheme of colouration; but this Indo-chinese species has the wing-markings black, and the black portion at the base of the hindwing is of considerably greater extent, reaching on costa as far as the fourth antenodal out of seven; its boundary also runs more regularly across the wing than in the present species. *Rh. severini* also has a denser venation than the new species, with a larger number of smaller cellules both in the post-trigonal space and in the hyaline portion of the anal area.

STUDIES ON AUSTRALIAN BRYOZOA.

No. 4.

By

ARTHUR A. LIVINGSTONE, Assistant in Zoology, Australian Museum.

THIS NUMBER CONTAINS NOTES ON SEVERAL SPECIES THAT REQUIRE FURTHER STUDY, AND A DESCRIPTION OF TWO NEW SPECIES.

(Plates xi-xiii.)

LEPRALIA MUCRONATA *Smitt* VAR. CELLEPOROIDES *Busk.*

(Pl. xii, figs. 5-6.)

Escharipora mucronata Smitt, Sv. Vet.-Ak. Handl. n.s., xi, 1872, p. 24, pl. v, figs. 113-115 (typical form).
Lepralia celleporoides Busk, " Chall.," Zool., x, pt. xxx, 1884, p. 142, pl. xvii, fig. 4.
Lepralia mucronata var. unipora Waters, Bry. Supplement, " Chall.," Zool., xxxl, pt. lxxix, 1888, p. 26.
? *Lepralia mucronata* Kirkpatrick (non Smitt), Sci. Proc. Roy. Dub. Soc., vi, n.s., 1890, p. 612.

The characters of this variety are set out by Busk (*loc. cit.*).

Remarks.—After Busk described *Lepralia celleporoides*, Waters (*loc. cit.* 1888) considered it in his list of references a synonym of Smitt's *Lepralia mucronata*, a view that I cannot follow for reasons set out herein. In the first place we read in Waters' text that the series (his Tertiary specimens of *Mucronella mucronata* and Busk's *celleporoides*) should perhaps be divided into varieties; this alone indicates doubt in the author's mind how the forms should be dealt with. Acting upon the suggestion, however, together with other data, I separate *celleporoides* of Busk from Smitt's typical *L. mucronata* as a variety and in doing so cannot accept the varietal name *unipora* suggested by Waters, because the name *celleporoides* takes priority.

Specimens in the Australian Museum collection from Nichol Bay, Western Australia, agree in every detail with Busk's description and figures of specimens from off Cape York, north Australia. Because the same form, showing the same characters, has been found in two different localities we have another reason for acting upon Waters' suggestion of separation.

Miss Jelly in her " Synonymic Catalogue," page 129, evidently follows Waters on the above question, for she merely quotes that author's synonymy.

MacGillivray[1] maintains that Waters' " *Mucronella* " *mucronata*

[1]MacGillivray—Trans. Roy. Soc. Vict., iv, 1895, p. 62.

from the Australian Tertiary Deposits has no connection with the true "*M.*" *mucronata* of Smitt, and considers it identical with *Hiantopora liversidgei* Tenison-Woods. Having examined specimens from the Australian Tertiaries I uphold MacGillivray's contention, and, further, maintain that "*M.*" *mucronata* of Smitt has no specific connection with *Hiantopora liversidgei* Tenison-Woods. *Lepralia mucronata*, therefore has only one variety, var. *celleporoides* Busk.

The variety has been recorded from "Challenger" Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud (Busk); ? Albany Pass., Somerset, N. Queensland, 10 fathoms (Kirkpatrick).

There are specimens in the Australian Museum from Nichol Bay, Western Australia; presented by Mr. W. H. Wooster.

LEPRALIA VESTITA *Hincks* VAR. AUSTRALIS *Waters.*

Lepralia vestita Waters (non Hincks). Ann. Mag. Nat. Hist. (5), xx, 1887, p. 194, pl. vi, fig. 21.

Lepralia vestita Hincks *var. australia* Waters, Ann. Mag. Nat. Hist. (6), iv, 1889, p. 12, pl. i, fig. 19.

? *Lepralia rostrigera* Waters (non Smitt), Quart. Journ. Geol. Soc., xliii, 1887, p. 61, pl. vii, fig. 17.

Description.—Zoarium encrusting. Zooecia hexagonal, ovate and separated by well defined and slightly raised margins. Frontal zooecial walls punctured with numerous minute pores. On each side of the zooecial aperture and alongside the zooecial margins is a large pore as seen in *Lepralia rostrigera* Waters (*loc. cit.*, *non* Smitt). These lateral pores are, however, not distinguishable in every zooecium on the specimen before me.

Peristome well developed, thick and massive, its distal extremity slightly elevated much in the same manner as in *Schizoporella acuminata* Hincks, but not so pronounced as in that species. The peristome on each side of the aperture is raised into an umbo-like eminence.

The zooecial aperture is typical of the genus, rounded distally and proximally, and contracted slightly at the sides. Two prominent hinge teeth are present, one on each side of the aperture.

Colour.—In a dried condition the colony is brown.

Locality.—Described and figured from a specimen from Green Point, Port Jackson, New South Wales (type locality of variety).

Synonymy.—Closely allied, if not identical, is a species from a Tertiary deposit in New Zealand, which was described by Waters (*loc. cit.* 1887) as *Lepralia* [*Escharella*] *rostrigera* Smitt.[2] This latter species was found by Waters[3] to be identical with *Lepralia depressa* Busk,[4] but he did not include in the synonymy the New Zealand species he previously identified as Smitt's *L. rostrigera*.

In the same year, 1889, Miss Jelly, on p. 126 of her "Synonymic Catalogue," includes *rostrigera* Smitt[2], together with Waters' supposed "*rostrigera*" from New Zealand, in the synonymy of *Lepralia depressa*

[2]Smitt—Sv. Vet.-Ak. Handl., n. ser., xi, 1872, p. 57, pl. x, figs. 203-5.
[3]Waters—Ann. Mag. Nat. Hist. (6), iv, 1889, p. 13.
[4]Busk—B.M. Cat. Mar. Poly., 1854, p. 75, pl. xci, figs. 3-4.

Busk. I do not wholly agree with this course. The true *rostrigera* of Smitt is, according to Osborn[5] not synonymous with *L. depressa* Busk, nor do I consider that the "*rostrigera*" from New Zealand is the same. I have compared specimens of *L. depressa* with Waters' figure of his so-called "*rostrigera*" but cannot detect any great degree of likeness. Therefore the New Zealand "*rostrigera*" will require a new name, if my surmise that it may be identical with *L. vestita* var. *australis* is incorrect.

PETRALIA UNDATA *MacGillivray.*

(Pl. xii, figs. 1-3.)

Petralia undata MacGillivray, Trans. Proc. Roy. Soc. Vict., ix, 1, 1868, p. 141.

Petralia undulata Maplestone, Trans. Proc. Roy. Soc. Vict., xviii, 1882, p. 51.

Petralia undata Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 203 (and synonymy).

Petralia undata MacGillivray, Trans. Proc. Roy. Soc. South Austr., xiii, 1890, p. 5.

This well differentiated species is very common off the southern New South Wales coast and has often been brought to light by trawlers operating in that region. Specimens of the species recently secured by my colleague Mr. W. Boardman when accompanying the trawler "Bar-ea-mul" on one of her cruises are of great interest. Not only does the collection prove the abundance of the species in the locality, but many specimens possess a remarkable tape-like filament which anchors the colony to the sandy sea floor on which it occurs.

MacGillivray[6] states that the colonies are "probably of considerable size, as all the specimens I have seen are broken on the edges."

All the specimens I have seen appear to be broken on the edges also, but I doubt if they will ever be found appearing any other way. My reason for doubt is that the material before me possesses anchoring filaments which appear to be complete, the so called broken edges being a natural state. The edge from which a filament arises is no different to a free edge of a colony, and thus it is not likely that the "fragments" would grow anchoring filaments if they were broken off a parent colony possessing quite a different anchoring arrangement.

The species has been recorded from Portland and Queenscliff in Victoria, and from South Australia (MacGillivray).

Localities.—There are specimens in the Australian Museum from the following localities:—S.W. of Eden, New South Wales, 45 fathoms, collected by W. Boardman; 3 to 4 miles off Eden, 25 to 30 fathoms, collected by H. O. Fletcher and A. A. Livingstone; 12 to 22 miles N.½E. from Green Cape, New South Wales, 39 to 46 fathoms, collected by H. O. Fletcher and A. A. Livingstone; Westernport, Victoria, collected

[5] Osborn—Papers from the Tortugas Laboratory, Carnegie Inst. Wash., 5, 1914, p. 211.

[6] MacGillivray—in McCoy's Prod. Zool. Victoria, dec. vi, 1879, p. 45.

by J. Gabriel; Port Phillip, Victoria, collected by J. B. Wilson; off Launceston and Devonport, Tasmania, collected by the Commonwealth Fisheries Investigation steamer "Endeavour."

HASWELLIA CORONATA *Reuss.*

(Pl. xii, fig. 4.)

Cellaria coronata Reuss, Fossile Polyparien d. Wiener tertiär Beckens, Haidinger Naturw. Abhandl., ii, 1848, p. 62, pl. viii, fig. 3.

Porina coronata Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 209 (synonymy).

Haswellia coronata Levinsen, Morph. and Sys. Stud. Cheil. Bryozoa, 1909, p. 299.

A specimen of the species recently trawled in deep water off the coast of New South Wales near Eden shows evidence of a remarkable mode of attachment. The colony is composed of somewhat flattened branches arising from a perfectly cylindrical rod of calcareous material. This cylindrical pillar-like structure appears to have been at one time a column of zooecia, but, as calcification has been carried on to such a considerable extent, I cannot be certain on this point; to section the colony would mean its destruction as evidence of its scheme of attachment. At the extremity of the unbranched end of the calcareous column is a pore, from the interior of which arises a brown filament of delicate texture resembling that seen in *Petralia undata* MacGill. The pore extends inwards some distance, thus giving the column a hollow appearance, but whether the column possesses a complete hollow axis is not known. The whole colony is attached to the sandy sea floor, no doubt by the burial of part of the anchoring filament referred to above.

Locality.—S.W. of Eden, New South Wales, 45 fathoms, collected by W. Boardman on trawler "Bar-ea-mul," July, 1925.

ESCHAROIDES LARVALIS (*MacGillivray*).

(Pl. xi.)

Lepralia larvalis MacGillivray. Trans. Proc. Roy. Soc. Victoria, ix, 1868 (1869), p. 134.

Porina larvalis Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 210 (and synonymy).

Lepralia larvalis MacGillivray, Trans. Proc. Roy. Soc. Victoria, iv, 1895, p. 104, pl. xiv, fig. 26.

Escharoides larvalis Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 318.

Specimens from Tasmania, which form a new record for the distribution of the species, are extremely well preserved, and having attained full zooecial growth without excess of calcification, have been used to figure and redescribe the species.

Description.—Zoarium loosely adnate. Zooecia not distinctly defined when viewed on the frontal surface, but when the basal surface

is examined the zooecia are seen to be roundly hexagonal. The frontal zooecial walls are perforated distally each with two large foramina and proximally with small foramina or pores. The latter, like the pores of *H. ferox* MacGillivray, possess small teeth or denticles on their inner edges. On the frontal walls of many zooecia is a somewhat regular pattern of raised lines, but such pattern is absent on distorted zooecia. The pattern commences at the proximal lip of the peristome and proceeds for some distance in a proximal direction as a straight median line; it then branches into three parts, two deviating laterally and one continuing onward until it reaches the small foramina or pores where it becomes lost. The two large foramina situated distally in the frontal wall lie immediately below the two lateral branches of the pattern and are divided by the continued median branch.

The basal zooecial walls, which collectively form the encrusting surface of the colony are thin and membranous. When the colony is incinerated these membranous walls disappear entirely. The peristome is strongly developed, produced, and easily seen with the unaided eye. It is produced distally and proximally into thin walls, but laterally is raised very little above the surrounding frontal walls. The produced proximal lip is, to some extent, supported by the rib-like line commencing the pattern referred to above. The situation of the peristome is not directly upright or vertical, but surrounds an imaginary axis directed distally, and at about forty five degrees to the horizontal plane.

Hollow calcareous spines occur in the neighbourhood of the peristome, generally one on each side, but in some cases four may be found, two occurring on each side. The produced peristomial lips of a zooecium on which four spines occur are always reduced in width but never in height. The peristomial apertures are irregularly circular or elliptical.

Avicularia occur on raised eminences or umbos, which are scattered at random all over the frontal surface of the colony. The mandible is long and triangular, wide, and sharply cornered at its base. The structure tapers towards its free extremity, where it ends in a curved point. The avicularian cavity is very deep, rounded at its widest end, and tapering to a sharp point. The lateral edges of the avicularian cavity are distinctly serrated or toothed. A distinct cross-bar is present, on which the base of the avicularian mandible is attached. Ooecia are not present on the specimens before me.

Described and figured from a specimen of a series from Banks Strait, Tasmania.

Colour.—Dried colonies are of a dull brown hue.

Localities.—Living specimens have been recorded from :—Western Australia (Waters); South Australia, Semaphore (MacGillivray and Waters); Victoria (Waters and MacGillivray); Williamstown (MacGillivray); New South Wales, Bondi Bay (Waters and Whitelegge); Norah Head (Bretnall).

Tertiary records are.—South Australia, Mount Gambier (Waters); Victoria, Bairnsdale (Waters and MacGillivray); Moorabool (MacGillivray); Fyansford, Griffins, Corio Bay, Mitchell River, Flinders, Muddy Creek (Maplestone).

There are specimens in the Australian Museum from :—Banks

Strait, Tasmania, 1924 (on weed), collected by Dr. W. E. J. Paradice, R.A.N., ; Tasmania, collected by Rev. Dr. Thos. Porter.

Affinities.—A near ally to this species appears to be *Hiantopora halli* MacGillivray,[7] but comparison of the description and figures serve to distinguish readily between them. Waters[8] considers that his *Porina*(?) *bioculata* is also "clearly related" to *E. larvalis*.

Remarks.—Fresh colonies are covered by a heavy brown membrane, which, until removed by incineration, obliterates many important characters.

LEPRALIA BICORNIS *Thornely.*

(Pl. xii, fig. 8.)

Lepralia bicornis Thornely, Trans. Linn. Soc., (2), xv, 1912, p. 151, pl. viii, fig. 11.

Specimens of this species from New Caledonia do not possess avicularia, though almost every other character described by Miss Thornely can be distinguished. An incinerated fragment shows the frontal zooecial walls to be very rough near their borders, a character not discernible on fresh specimens. The pores around the borders of the zooecia are very conspicuous owing to their large size and depth. The sutures dividing the zooecia are very deep. Zooecial apertures a little more elongate than figured by Miss Thornely; a prominent hinge tooth is present midway on each lateral border.

Localities.—Indian Ocean; Cardagos, 30 fathoms; Salomon, 75 fathoms (Thornely). There are specimens in the Australian Museum from Anse Vata, Noumea, New Caledonia, coll. A. F. Basset Hull, August, 1925.

LEPRALIA UNITURRITA *sp. nov.*

(Pl. xii, fig. 7, and Figs. 1-2.)

Zoarium encrusting, thick and strong. The zooecia are broadly ovate and their frontal zooecial walls are provided with a number of uniformly arranged pores. The zooecia are rounded in outline and are separated by conspicuous furrows as well as by their common walls.

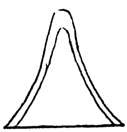

Fig. 1

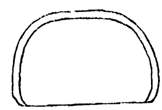

Fig. 2.

Lepralia uniturrita sp. nov. 1. An avicularium from the top of one of the columns. 2. Operculum.

They are entirely covered with a glistening epitheca, which, when removed by incineration, allows an uninterrupted view of the outside zooecial structure.

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[7]MacGillivray—Trans. Proc. Roy. Soc. Victoria, iv, 1895, p. 61, pl. viii, fig. 25.
[8]Waters—Quart. Journ. Geol. Soc., xlvii, 1890 (1891), p. 26, pl. iii, f. 15.

The zooecial aperture, which occupies about one third the area of the entire frontal zooecial wall, is typical of the genus. It is as broad as long, arched above, contracted on each side below the middle, and has the lower margin straight or sometimes faintly turned outwards. A hinge tooth is present on each side of the aperture below the middle. A distinct peristome is present, which has much in common with that seen on normal colonies of *Lepralia pallasiana*. The operculum is not heavily chitinised and fits the zooecial aperture perfectly. Its structure is supported by a chitinous thickening, which continues the whole way around the operculum at slight varying distances from the edges. On each side there is a strong articular thickening as well. On one side of the aperture there is a strong and well calcified vertical column. This structure is hollow and is, in many cases, as high as the aperture is broad. Upon the free extremity of this stout column is a small elongated avicularium with a rounded point. A central cross-bar is present in the mandibular cavity, which, in reality, represents the hollow axis of the column. No other type of avicularium occurs on the colony.

There are no ooecia on the specimen before me.

Colour.—Dull cream in a dried condition.

Variation.—Save for the apertures, which may vary slightly in relative length and breadth, no variation occurs on the single specimen before me.

Affinities.—The only known species liable to be confused with this form is *Lepralia gigas* Hincks,[9] but *L. uniturrita* can be distinguished from this form by the large vertical column and the comparatively small ovate zooecia.

Locality.—Broughton Island, off Port Stephens, New South Wales.

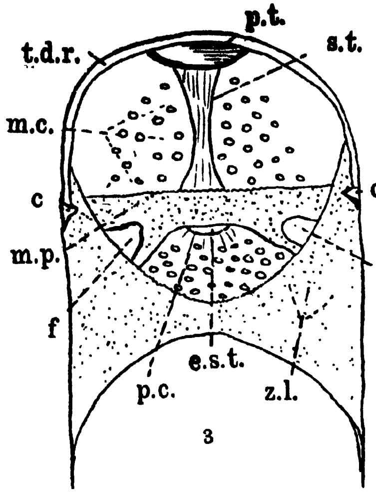
STEGANOPORELLA GREAVESI[10] *sp. nov.*

(Pl. xiii, figs. 1-3 and Figs. 3-8.)

Description.—Zoarium unilaminate, large and massive; seemingly of a loosely encrusting nature. Zooecia large, well defined, and with large raised borders. A conspicuous thickening occurs on each zooecium on the distal border of the aperture, and continues down each lateral border, ending abruptly at the condyle on each side. Only " A " type of zooecia and opercula can be distinguished on specimens before me. The zooecial aperture is dome-shaped distally and occupies about one half the area of the frontal surface. A continuous ledge runs around the internal sides of the upright zooecial walls and is lowest distally. Its proximal edge, which is highest, appears serrated owing to the strongly tubercular nature of the entire structure. The cryptocyst, which is perforated proximally, descends gradually at first, then dips suddenly, forming an almost vertical wall. It then turns again at right angles and proceeds towards the distal wall, which it joins about midway. The polypide tube is situated in the distal extremity of the cryptocyst, and is in a median position from the lateral walls. It is vertical and

[9] Hincks—Ann. Mag. Nat. Hist. (5), xv, 1885, p. 255.

[10] Named for Mrs. Lilian Wooster Greaves of Perth, Western Australia.



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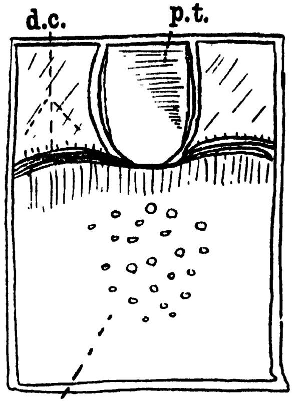

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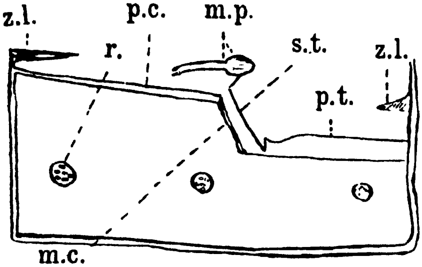

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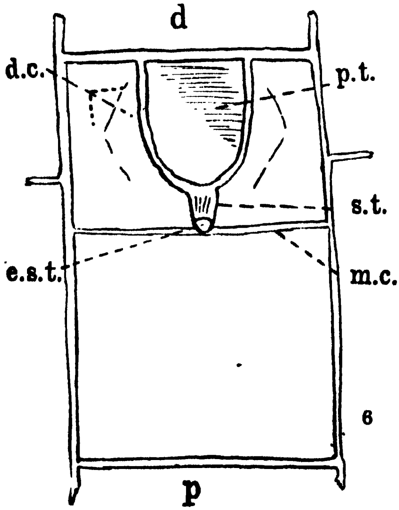

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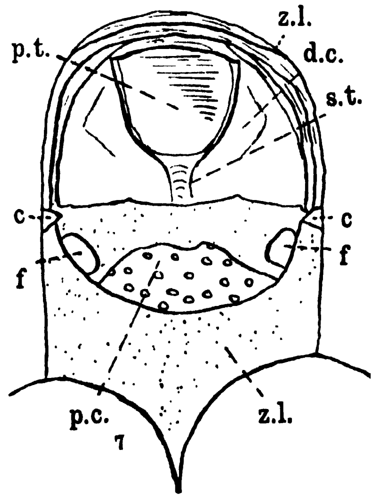

7

Figures 3–7.

its proximal and lateral walls are very short. A portion of the distal zooecial wall acts as a distal wall to the polypide tube. A cross section of the tube shows the distal wall (part of distal wall of zooecium) to be straight, the lateral walls almost straight, and the proximal wall concave. The cryptocyst is perforated by a large opening immediately below the median process. The opening is the entrance to a small almost vertical tube which proceeds downward on the distal side of the median and downwardly directed portion of the cryptocyst until it connects with the proximal wall of the polypide tube.

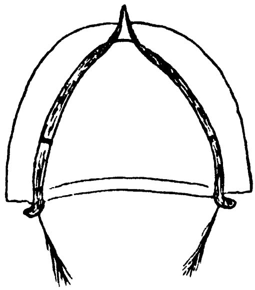

Fig. 8.

Steganoporella greavesi sp. nov. Operculum.

The median process has a thickened distal wall which joins the lateral walls immediately below the condyles. It dips downwards as it proceeds proximally, and joins the lateral edges of the zooecial ledge by two processes in such a way as to form a large foramen on each side. The median process is deficient proximally, and through the opening can be seen the proximal perforated portion of the cryptocyst beneath.

The polypide tube and the secondary tube can be properly seen only when the median process and the proximal (highest) portion of the cryptocyst is removed by sectioning, or when the colony is tilted under the microscope. When the basal zooecial wall is removed only the descending cryptocyst and the large funnel-like polypide tube in the last and horizontal turn of the cryptocyst just before it reaches the distal wall, can be seen.

EXPLANATIONS TO FIGURES 3 TO 7.

Steganoporella greavesi sp. nov. Fig. 3. Normal zooecium showing structure seen when the colony is tilted to about 45 degrees under the microscope. Fig. 4. View of zooecium when the basal wall is removed. Fig. 5. Section through zooecium, lateral view. Fig. 6. Front view into zooecium when the proximal cryptocyst, the zooecial ledge, and median process are removed by sectioning. Fig. 7. Normal zooecium, showing structure when slightly tilted or inclined under the microscope. The entire structure cannot be seen or clearly made out in one focal plane.

Key to abbreviations.—c. Condyle. d. Distal. d.c. Distal portion of cryptocyst. e.s.t. Entrance to secondary tube. f. Foramina. m.c. Median (almost vertical) portion of the cryptocyst. m.p. Median process. p. Proximal. p.c. Proximal portion of the cryptocyst. p.t. Polypide tube. r. Rosette plate. s.t. Secondary tube. t.d.r. Thickened distal border of the aperture. z.l. Zooecial ledge.

The operculum is semicircular, not heavily chitinised, and with a U-shaped main sclerite. The two basal extremities of the main sclerite are considerably thickened for articulation with the condyles. On each side of the sclerite within the basal half is another thickening. At the top of the operculum is a large tooth formed by the continuation of the inside bar of the main sclerite.

Described and figured from normal zooecia and sectioned portions of colonies.

Colour.—Dull cream in a dried condition.

Locality.—Near Perth, Western Australia. Presented by Mrs. Lilian Wooster Greaves, through Mr. W. H. Wooster, an Honorary Correspondent of this Museum.

ARACHNOPUSIA ACANTHOCEROS (*MacGillivray*).

(Pl. xiii, fig. 4.)

Cribrilina acanthoceros MacGillivray, in McCoy's Prodr. Zool. Victoria, dec. xx, 1890, p. 320, pl. 187, fig. 7.

Arachnopusia acanthoceros Livingstone, Rec. Austr. Museum, xiv, 3, 1924, p. 204.

Having recently acquired a specimen of this species from Rev. Dr. Thos. Porter, who collected it in Victoria, I am able to amplify the remarks made in a previous paper (*loc. cit.*).

Stress has been laid both by MacGillivray and myself upon the character of the large oral spine as a distinguishing feature of the species. MacGillivray's figure shows the spine to be jointed, and infers that the basal portion is stunted and many times shorter than the free portion. While his specimens may have shown such a condition, the specimens before me prove the basal joint to be, in many cases, just as long as the free portion, the two together in their natural state being extremely huge. Only the free portion of the spine possesses the characteristic "prickles" as MacGillivray calls them.

Not knowing these facts, and having only a specimen in which the free joints of the spines were missing, one would be led to believe that at least a new variety of the species had been secured. Indeed, so complete and robust looking is the remaining portion of the spine that reference to MacGillivray's figure would not suggest or even hint at similarity in the structure of this portion of the spine.

BRACHYURAN CRABS FROM AUSTRALIA AND NEW GUINEA.

By

Dr. Mary J. Rathbun, Associate in Zoology, United States National Museum.

(Plates xiv.-xvi.)

A small collection of Australian crabs has recently been received at the United States National Museum from Mr. Melbourne Ward of Sydney. It includes a new species of *Cleistostoma* and specimens of four known species.

About the same time the Australian Museum sent for examination specimens of two species of river crabs from New Guinea, which appear to be new. These were collected by Mr. E. A. Briggs, M.Sc., while engaged on zoological work for the University of Sydney, on the north-east coast of the Mandated Territory of that island. The collecting base was near the headwaters of a small stream, the Wakip River, which enters the sea close to Cape Djeruen, 50 miles south-east of Aitape.

Examples of two already known species (listed below) were also represented in the small collection brought back by Mr. Briggs.

The known species (from both sources) with their localities are as follows:

Ozius truncatus Milne Edwards. Port Adelaide, South Australia; under stones between tides on sand.

Ocypode cordimana Desmarest. Sandgate, Queensland; on sand hills at back of shore and above high water mark.

Uca marionis (Desmarest), var. *vomeris* McNeill. Mouth of Brisbane River, Queensland; on mud flats.

Euplax tridentata (A. Milne Edwards). Mouth of Brisbane River, Queensland; on mud flat, among mangroves.

Varuna litterata (Fabricius). Under stones in bed of Wakip River, north coast New Guinea, close to its source; water fresh and flowing. Species common.

Macrobrachium placidulus (de Man). Wakip River, north coast New Guinea. Occurred in rocky pools in the bed of the river two miles inland from the sea coast. At time of collecting the stream was a disconnected line of similar pools in many places, which contained pure drinking water. Only one specimen was secured, but the collector states that the species was common in occurrence.

The writer is indebted to Mr. Frank A. McNeill for the privilege of describing the two new species from New Guinea.

Family OCYPODIDAE.

Subfamily MACROPHTHALMINAE.

Genus CLEISTOSTOMA *de Haan.*

CLEISTOSTOMA WARDI, *sp. nov.*

(Plate xiv.)

Type-locality.—Sandgate, mouth of Brisbane River, Queensland; on mud flats. Five males. The type specimen is in the Australian Museum, Reg. No. P.8489.

Measurements.—Male holotype, length of carapace 12.2, width of same 17.6, fronto-orbital width 13.2, anterior width of front 3.4 mm.

Diagnosis.—Lateral margins of carapace strongly arcuate. Orbital margins sloping forward and outward. Merus of outer maxilliped punctate. Arm not reaching beyond carapace; palm nearly as high as long. Ambulatory legs densely hairy.

Description.—Carapace slightly convex, smooth; a transverse, curved furrow behind gastric region, a broad and deep median furrow on the front, epigastric lobes prominent, cardiac and intestinal regions defined, hepatic region depressed. Margin of carapace subacute, raised and finely milled, as is also the slightly sinuous line subparallel to, and above, the posterior margin. Front inclined downward, anteriorly narrow, about a fifth of carapace width, margin arcuate in front view, appearing bilobed in dorsal view; sides sinuous; posterior width less than a third of carapace width. Orbital margin sinuous, directed obliquely forward to the produced outer angle. Inferior margin of orbit granulate, granules for the most part separated, but finer and close toward outer end. Lateral margin of carapace arcuate.

Median tooth of epistome lobiform, the epistomial margin on either side convex. Merus of outer maxilliped broader than long, coarsely punctate, a bipartite furrow branching from the antero-external angle. Chelipeds of moderate length; when they are folded against the body the merus does not reach beyond the lateral margin of the carapace. Margins of arm acute, finely granulate; wrist longer than broad, inner margin rounded, without tooth; chelae of male heavy; palm swollen, lower edge with a sinus near base of finger; fingers slender, gape triangular, immovable finger nearly horizontal, shorter than dactylus, which has near its base a single truncate tooth, round in cross section; prehensile surfaces broad, with two granulate edges, outer coarser than inner, tips spooned. Postero-lateral slope of carapace, upper and posterior surfaces of second, third and fourth legs and upper surface of merus of first leg covered with long hair of two sorts, one coarse and thick, the other finer and longer.

The first segment of the male abdomen follows the curve of the carapace; it is pubescent and crossed transversely by a sharp crest. In the coalesced segment (second to fifth, inclusive), a partial suture between second and third segments is visible at the sides; the third,

fourth, fifth and sixth segments have each separately convex side margins; sixth segment five-eights as long as greatest width; length and breadth of seventh segment subequal, tip arcuate.

Remarks.—Mr. Ward states that he found the species to be very common on the mud flats.

Family POTAMONIDAE.

Subfamily GECARCINUCINAE.

Genus CYLINDROTELPHUSA *Alcock.*

Cylindrotelphusa Alcock, Catal. Ind. Dec. Crust. Indian Mus., part 1, fasc. 2, Potamonidae, Calcutta, 1910, pp. 121 and 124.

To this genus (? or subgenus) belong the following:

C. steniops (Wood-Mason), type of the genus; India.
C. macropus (Rathbun); Monrovia.
C. montanoana (Rathbun); Philippines.
C. perrieri (Rathbun); Congo.
C. ingrami (Calman); New Guinea.
C. wakipensis Rathbun; New Guinea.

CYLINDROTELPHUSA WAKIPENSIS, *sp. nov.*

(Plate xv.)

Type-locality.—At foot of mountain range, close to head waters of Wakip River, north coast of New Guinea; E. A. Briggs, collector, 1924; four females, of which one is the type, Reg. No. P.8486, Australian Museum.

Measurements.—Female holotype, length of carapace 28.3, width of same 31.6, fronto-orbital width 16.7, width of front 6.5, height of body 19.6 mm. Female paratype, in paper-shell condition, length of carapace 28.3, width of same 32.6, fronto-orbital width 17.3, width of front 7.7, height of body 19.4 mm.

Diagnosis.—Carapace almost imperceptibly broader than long. Area enclosed by cervical suture sub-oblong rather than sub-triangular. Orbital tooth and epibranchial tooth well formed. Upper edge of orbit sloping outward and forward. Sides of front oblique, not subparallel.

Description.—Carapace strongly convex antero-posteriorly; very narrow, length about nine-tenths of width; surface coarsely and unevenly punctate and minutely granulate all over; toward lateral margins some short, fine, granulate ridges; epigastric lobes vermiculated; depression behind front and orbits crossed by numerous fine impressed lines; similar lines on intestinal region. The forward part of the cervical groove begins a little behind the hepatic region; it is directed toward the outer angle of the orbit, and continued backward and slightly inward in a sinuous line, being interrupted before it reaches the mesogastric region; along the sides of this region the groove is wider and deeper than elsewhere, but narrow between gastric and cardiac regions;

grooves deep on either side of cardiac region; post-frontal groove narrowly bifurcate, but not continued in front of epigastric lobes. Regions distinct and separately tumid. Front very broadly triangular, margin sinuous, median point bent backward to meet the epistome. Orbits wide (vertically), outer angle dentiform, prominent, subacute, not separated by a gap from lower border. Antero-lateral borders shorter than postero-lateral, rimmed, the rim punctate, set off by a groove above, and terminating anteriorly in a blunt rectangular epibranchial tooth.

Basal article of outer antenna obliquely placed with its whole length across the broad orbital gap; flagellum half as long as greatest dimension of orbit. Median tooth of free edge of epistome equilaterally triangular, vertically deflexed; margins on either side more advanced than edge of front, sinuous, the highest part above the tubular efferent branchial openings.

Chelipeds unequal in female; merus with inner and upper margins dentate, outer margin rimmed, distally dentate, outer surface with sharp squamiform granules. Surface of carpus punctate and vermiculate, a conical acuminate spine at inner angle, and a stout spinule below the angle. Chela punctate and finely granulate, palm swollen; fingers, measured from gape, nearly as long as palm, grooved, gaping narrowly at base, armed with numerous small rounded teeth or lobes, tips crossing.

Legs narrow, slightly rough; merus with a subdistal spine; upper margin of merus and both the upper and lower margins of propodus spinulous; larger spinules on the four margins of the slender dactyls, which are longer than their respective propodites, measured along upper margin.

Variation.—The carapace of the measured paratype, though of the same length as that of the holotype, is a little wider, its anterior portion more depressed and less compressed laterally, the orbits in consequence not so slanting; the front appears a little less triangular, while the median tooth of the lower edge of the epistome is flatter (less concave) and therefore wider. The two additional paratypes are smaller and not susceptible of measurement; all have a well formed secondary spine on the carpus of the cheliped.

Relation.—This species is very near *C. ingrami* (Calman)[1], but is distinguished from it by the narrower carapace, the more longitudinal and more sinuous lateral limbs of the cervical suture, the greater size of the outer orbital tooth, the presence of a small spine on the wrist below the spine at inner angle.

Remarks.—Mr. A. E. Briggs states that clay castings from the burrows of this species occurred on the banks of the Wakip River close to its headwaters, which are about 2½ miles from the sea coast. Upon excavation, tunnels about four inches in diameter were revealed running down obliquely into the earth for a distance of about two feet. Similar castings and burrows were plentifully distributed on both banks of the stream for a distance of about 300 yards. In this area the surface of the banks is hard yellow clay, but at a little depth this becomes soft and moist. In this moist clay the burrows of the crabs terminated in a water-filled chamber, which invariably contained a specimen.

[1]Calman—Proc. Zool. Soc. London, 1908, p. 960, pl. xviii.

Genus PARATHELPHUSA *Milne Edwards.*

Subgenus LIOTELPHUSA *Alcock.*

Liotelphusa Alcock, Catal. Ind. Dec. Crust. Indian Mus., part 1, fasc. 2, Potamonidae, Calcutta, 1910, pp. 71 and 109.

From Alcock's definition should be excluded, "No spine on upper border of merus of chelipeds."

PARATHELPHUSA (LIOTELPHUSA) BRIGGSI, *sp. nov.*

(Plate xvi.)

Type-locality.—Headwaters of the Wakip River, north coast of New Guinea; E. A. Briggs collector, 1924; one male holotype, Reg. No. P.8488, Australian Museum.

Measurements.—Male holotype, length of carapace 14.7, width of same 17, fronto-orbital width 11.3, width of front 5.3, height of body 8.6 mm.

Diagnosis.—Width of carapace 1.15 times length. Short, deep carapace furrows. Wrist bispinose. Legs slender, of moderate length. Sixth abdominal segment in male longer than broad.

Description.—Carapace moderately convex, nearly flat from side to side except near the margins; narrow, length about 6/7 of breadth; epigastric lobes well marked, eroded; no postorbital lobes; a continuous depression behind front and orbits; front bent downward and inward forming a crest entirely across the front. A deep median furrow, not continued on the front; the lateral sections of the cervical suture short, straight, not reaching the hepatic region nor the mesogastric region; a broad furrow behind the gastric region, interrupted at the middle, but with a small branch either side. Deflexed portion of front broadly triangular, concave. Outer orbital angle rectangular; antero-lateral margin acute, finely granulate, epibranchial tooth insignificant, obtus-angular; short raised lines run obliquely inward from the whole lateral margin. Dorsal surface coarsely punctate.

Only the right cheliped is present; it appears to be the minor, and is shorter than the first ambulatory; outer and upper surface crossed by short rugae; merus with a short, acute, subdistal tooth above; carpus with a stout, conical, sharp inner, tooth or spine and below and proximal to it a small denticle; fingers narrow, a little longer than palm measured from the gape, grooved, narrowly gaping in proximal half, edges feebly dentate. Ambulatory legs narrow, slightly roughened; upper edges of merus roughened with short rugae except in last pair where it is margined; a small, rectangular, subdistal tooth above; dactyli coarsely spined, a little longer than their respective propodites measured on the upper margin.

The male abdomen is of the same type as that of *P.* (*L.*) *aruana* Roux,[2] but the fifth segment is wider (from side to side) and the seventh is also wider except at proximal end, and more oblong.

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[2]Roux—Abhandl. Senck. Naturf. Ges., Frankfurt am Main, xxxv, 1919, text-fig., p. 345.

Relation.—The Wakip River specimen, although closely related to Roux's *aruana*,[3] can hardly be referred to it; it is narrower than the narrowest of the variations listed by Calman,[4] the lengthwise furrows of the cervical suture are more convergent, the legs slenderer; the abdomen differs as above stated. Similarly, our species cannot be combined with *P.* (*L.*) *wollastoni* Calman,[5] on account of its narrower carapace; deeper carapace furrows; more evident epibranchial tooth; antero-lateral marginal line longer, extending about two-fifths the length of the carapace; shorter ambulatory legs; differently proportioned abdominal segments.

Remarks.—The collector informs me that he secured several examples of this species in the headwaters of the Wakip River, which rise in the mountain ranges about 2½ miles inland from the sea. They were found under stones in the bed of the stream at the foot of a waterfall. Where the species occurred the water was perfectly fresh and flowing, but specimens were not very plentiful.

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[3]Roux—Notes Leyden Mus., xxxiii, 1911, p. 91.
[4]Calman—Trans. Zool. Soc. London, xx, 1914, p. 313.
[5]Calman—Trans. Zool. Soc. London, xx, 1914, p. 310, text-fig. 12.

NOTES ON A COLLECTION OF ECHINODERMS FROM THE AUSTRALIAN MUSEUM.[1]

By Hubert Lyman Clark,
Museum of Comparative Zoölogy, Cambridge, Mass., U.S.A.

(Figure I.)

Through the kindness of Dr. C. Anderson, Director of the Australian Museum, a collection of Echinodermata of more than ordinary interest was sent to me for identification in April, 1925. They were largely collected by Surgeon Lieutenant-Commander W. E. J. Paradice, R.A.N. (late H.M.A.S. "Geranium"), and chiefly on little known portions of the Great Barrier Reef, Queensland, between 17° and 19° S. lat. A few other localities are, however, represented. As several of the species have not hitherto been taken on the coast of Australia, and the records for many others show important extensions of range it seems to me worth while to publish an annotated list of the species contained in the collection. I sincerely thank Dr. Anderson for the opportunity to examine this material and I would add that credit is due Dr. Paradice for the important contribution he has made to our knowledge of the Australian marine fauna. There are in the collection altogether 101 specimens, representing 42 species.

CRINOIDEA.

Comatella stelligera (*P. H. Carpenter*).

The occurrence of these specimens on the Queensland coast is of interest because there are no authentic earlier records from south of the Torres Strait region. The present localities are: Off Ellison Reef, Queensland, 5-15 fms. August, 1924, 1 specimen. Dredged in 7 fms. on Surprise Shoal, outer Great Barrier Reef, Q'ld., about 18° S., 1 specimen.

Comatula pectinata var. purpurea (*J. Müller*).

I think Gislen (1919, Kungl. Svenska Vet.-Akad. Handl., 59, No. 4, p. 6) is right in his decision that *Comatula purpurea* (J. Müller) is only a form or variety of *C. pectinata*, but the three specimens in the present collection throw little light on the question. Two are rather large specimens with the oral arms 125 mm. long; they look like *pectinata*, but have the cirri as in *purpurea*. The third specimen is smaller, quite stout, with all the arms subequal; there are only two cirri and the colour is a bright orange-brown (rust-colour). This colouration has the appearance of being artificial.

Localities.—Off Ellison Reef, outer Great Barrier Reef, Queensland, 5-15 fms., Aug. 1924. 2 fine specimens. Outer Great Barrier Reef, Qld., between 17° and 19° S.; exposed reefs at low tide. 1 rust-coloured specimen.

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[1] *See* also paper by F. A. McNeill and A. A. Livingstone on pp. 193-199.

COMASTER MINIMUS (*A. H. Clark*).

This is a notable addition to the Australian fauna, as it was not previously known from any point nearer than Rotti. The present specimen has 21 arms, 75-80 mm. long, and no cirri. The III. br. series is present *four* times, and two of these being on one arm show the species character of III. br. 2, clearly. The colour of this individual is light brown, and the whole appearance is much more delicate than that of *Comatella*, *Comatula* or *Comanthus*.

Locality.—Off Ellison Reef, outer Great Barrier Reef, Queensland, 5-15 fms. August, 1924. 1 specimen.

COMANTHUS ANNULATUS (*Bell*).

The geographical range of the species is not affected by the present record:

Dredged in 7 fms. on Surprise Shoal, outer Great Barrier Reef, Queensland, about 18° S. 1 small specimen with 21 arms 40-50 mm. long, and 4 cirri.

COMANTHUS BRIAREUS (*Bell*).

The known range of this species is not affected by the present records.

Between tides, Feather Reef, outer Great Barrier Reef, Queensland, between 17° and 19° S. 1 large specimen with about 70 arms.

Dredged in 7 fms. on Surprise Shoal, outer Great Barrier Reef, Queensland, about 18° S. 1 small specimen with 40 arms or more; arms broken and often meeting.

HIMEROMETRA ROBUSTIPINNA (*P. H. Carpenter*).

The occurrence of this fine comatulid on the Great Barrier Reef is interesting because no member of the genus as now restricted has been known from Australian coastal waters, the nearest locality being at the Kei Islands. One of the specimens has 29 arms, and about thirty cirri, with 27-29 segments. The other has 36 arms, and the cirri are xxxii, 29-33. In both specimens the cirri have the dorsal teeth confined to the outermost segments; seldom more than six segments show the teeth clearly, and often only one.

Locality.—Off Ellison Reef, outer Great Barrier Reef, Queensland, 5-15 fms., August, 1924. 2 specimens.

ASTEROIDEA.

ARCHASTER TYPICUS *Müller and Troschel.*

Not new to the Queensland coast, yet of interest for the locality:

On bottom of lagoon, on sand flat, at low tide, Frankland Group, Great Barrier Reef. 1 dark-coloured specimen with R = 57 mm.

ASTROPECTEN POLYACANTHUS *Müller and Troschel.*

The specimens are small (R = 36 mm. and 43 mm.) but typical, except that the distal inferomarginal spines are more than usually long and slender. The colour is grayish-brown, with the long spines dirty whitish.

Locality.—Great Palm Island, Northeast Bay, 5 fms.; seaweed, on sandy bottom; dredged. 2 specimens.

CULCITA NOVAEGUINEAE *Müller and Troschel.*

A large dry specimen with R about 100 mm. bears only "Great Barrier Reef, Queensland" as its locality label. If the locality were in the vicinity whence most of the present collection came, it would be a notable extension of the range of the genus.

ANTHENEA ACUTA *Perrier.*

As this well-known Port Jackson species has been recorded from Frazer Island, Queensland, I refer to it a single small specimen (R = 35 mm.) from Hervey Bay; this is in rather poor condition, and has lost all its colour. The rays are rather slender, 15 mm. wide at base, and 11 mm. half way from the centre of the disc to the tip.

FROMIA ELEGANS *H. L. Clark.*

There are two *Fromias* from Coates Reef, outer Great Barrier Reef, Queensland, which seem to belong to this fine species, originally described from the Murray Islands, Torres Strait. They are very dark coloured, but this may be due to imperfect preservation.

The occurrence of *F. elegans* on the above named reef, between 17° and 19° S. lat., forms a notable extension of its range.

FROMIA MILLEPORELLA (*Lamarck*).

There are half a dozen *Fromias*, also from Coates Reef, outer Great Barrier Reef, between 17° and 19° S. lat., which are clearly this long-known species, although it has not hitherto been recorded from the mainland coast of Australia. The present specimens are of average size and all are pentamerous.

NARDOA NOVAECALEDONIAE (*Perrier*).

This species was not known hitherto from south of Green Island (off Cairns, Queensland) but there are two specimens of rather small size (R less than 60 mm.) in the present collection from Feather Reef, outer Great Barrier Reef, Qld., between 17° and 19° S.

LINCKIA GUILDINGII *Gray.*

A specimen of *Linckia* from Lord Howe Island, South Pacific (secured in 1888), labelled *L.* (*ehrenbergi* ?) seems to belong to this widespread species, the occurrence of which at Lord Howe Island is notable, but not extraordinary, as the species is already known from Masthead Island, Capricorn Group, Queensland.

The present specimen is, however, extraordinary in possessing 7 arms and only *one* madreporite; beginning with the longest arm and counting clockwise, the arms measure, in millimetres, 85, 80, 27, 35, 37, 16 and 68. The combination of a single madreporite with more than 5 arms is very rare.

OPHIDIASTER *sp* ?

The single specimen from Lord Howe Island, South Pacific has been artificially coloured and hence some of the essential features required

for identification are completely obscured. It is accompanied by a life-size sketch of a specimen taken at Lord Howe Island, Jan. 30, 1922. This sketch shows the colour in life to be brown-orange, with blotches and markings of a darker shade. The specimen itself is painted a brick-red.

After comparing this specimen with all the species of *Ophidiaster* available to me, I am inclined to consider it as representative of an undescribed species, but it is out of the question to attempt to describe it until better material is available. It differs from *O. confertus*, the species already known from Lord Howe Island, in several particulars, but especially in the adambulacral armature. These apparent differences may, however, be due to the large size of the present specimen (R = 125 mm.), and its unfortunate painted condition. More material of all the ophidiasterids occurring at Lord Howe Island is much to be desired.

ASTERINA EXIGUA (*Lamarck*).

This well-known species is represented by 5 specimens from the Frankland Group, Queensland, and 3 specimens from the outer Great Barrier Reef, Qld., between 17°-19° S.: at low tide. All are small, the largest being 26 mm. across.

ASTERINA GUNNII *Gray*.

There is a single well-preserved specimen of this species, 42 mm. in diameter, from Shellharbour, on the south coast of New South Wales.

OPHIUROIDEA.

OPHIOCOMA BREVIPES *Peters*, var. VARIEGATA *E. A. Smith*.

There are 10 specimens at hand of this perplexing brittle-star; of these, 3 are easily recognisable as forma *doederleini* de Loriol, and 7 are evidently forma *dentata* Lutken. All were collected July 7, 1924, between tides on the coral reef flat at High Island, Frankland Group, Great Barrier Reef, Queensland. This is a little further south than it had previously been secured. The largest specimens have the disc 20-24 mm. across. In *dentata* the size of the meshes in the reticulation of the disc shows great diversity; if the meshes are small, say, ·33 mm. across, the disc appears to be dark, but when the meshes are a full millimetre in diameter, the disc appears light.

OPHIOCOMA ERINACEUS *Müller and Troschel*.

There is a single small specimen from between tides in the coral pools at High Island, Frankland Group, Queensland, July 7, 1924. The disc is 9 mm. in diameter. Every other one of the uppermost arm-spines is noticeably swollen.

OPHIOCOMA SCHOENLEINII *Müller and Troschel*.

This species was collected with the preceding two at High Island in the Frankland Group, Queensland, on July 7, 1924. There are 2 specimens, 12-15 mm. in diameter of disc. Green Island, near Cairns, Queensland was the former southernmost known locality.

OPHIOCOMA SCOLOPENDRINA (*Lamarck*).

The collection contains a single specimen of this common and widespread species, from the south-western coast of Ysabel Island, British Solomon Islands. It was collected in August, 1924, by N. S. Heffernan, the local District Officer. The disc is 16 mm. in diameter and the arms are about 85 mm. long. The remarkable feature of this specimen, however, is that, save for a very few basal pores, there is only a single tentacle-scale on each of the arm-pores. It thus bears the same relation to *scolopendrina* that *schoenleinii* does to *erinaceus*. It will be convenient to have a name for so easily recognized a form, so I suggest that it be called " forma *monolepis*."

OPHIOMASTIX ANNULOSA (*Lamarck*).

This well-known brittle-star is represented by three specimens from the tide pools on Ellison Reef, outer Great Barrier Reef, Queensland. This is the farthest south that the species has been found to occur.

OPHIOMASTIX MIXTA *Lütken*.

The known range of this species is extended far to the south by a specimen collected July 17, 1924, by Dr. Paradice, on the reef-flat off High Island, Frankland Group, Queensland, which is between 17° and 18° S. lat.

OPHIARTHRUM ELEGANS *Peters*.

There are 9 specimens of this very common brittle-star from the Frankland Group, Queensland, 7 of them from the tide-pools on the reef-flat at High Island. They were taken July 17, 1924. Green Island, off Cairns, Qld., was previously the southernmost known locality for this species.

OPHIARACHNA INCRASSATA (*Lamarck*).

Green Island, off Cairns, Queensland, was the southernmost station known for this species, but in the present collection are the following, ranging in disc-diameter from 18 to 45 mm.

Coral reef-flat off High Island, Frankland Group, Queensland, July 17, 1924. 2 specimens. Feather Reef, outer Great Barrier Reef, Queensland, 17°-19 S. lat., between tides. 2 specimens.

* OPHIOLEPIS NODOSA *Duncan*.

The discovery of this species on the Queensland coast is the most interesting addition to the echinoderm fauna of Australia that has been made for several years. The species was previously known only from the holotype, an individual 18 mm. across the disc, taken at Elphinstone Island in the Mergui Archipelago. The arms were scarcely as long as the disc-diameter, and the colour was orange above, with some splashes of purple, and whitish below. The present specimen is not quite so large (13 mm. across the disc), the arms are relatively longer (16-18 mm.) and the colour is quite different, but in other respects it is perfectly typical and I have no doubt of the identification. The Queensland specimen is dull orange-brown above, the arms a trifle darker than the disc with half a dozen rather indefinite narrow cross-bands of purplish-brown; the kidney-shaped nodules between the radial shields are dull

greyish; the lower surface is dull greyish-brown, but under a lens this colour is seen to be due to numerous fine brown dots on a dirty-whitish background. This remarkable brittle-star was taken by Dr. Paradice on the reef-flat off High Island, Frankland Group, July 17, 1924.

ECHINOIDEA.

PRIONOCIDARIS BISPINOSA (*Lamarck*).

This specimen, though a wreck, is of special interest because of the locality. It was found washed up on the shore, May 27, 1920, after a tidal wave in the Gulf of Carpentaria, near Fat Feller (or Fatman's) Creek. Records of echinoderms from the Gulf of Carpentaria are still very few.

CENTRECHINUS SAVIGNYI (*Michelin*).

A single specimen from the "outer Great Barrier Reef, Queensland," between 17° and 19° S. is 47 mm. in diameter, very black, with scarcely a trace of red, and no trace of white.

CENTRECHINUS SETOSUS (*Leske*).

I refer to this species five young specimens, 9-15 mm. in diameter, because the peristomial region is white, but it is hard to make out any satisfactory white spots dorsally. The locality is recorded as simply Frankland Group, Great Barrier Reef, Queensland.

STOMOPNEUSTES VARIOLARIS (*Lamarck*).

At Northeast Bay, Great Palm Island, 2 small specimens, 13 and 15 mm. in diameter, were dredged in 5 fms. amongst seaweed on a sandy bottom. The species is already known from the Queensland coast.

TEMNOPLEURUS TOREUMATICUS (*Leske*).

One small specimen, 17 mm. h.d., is in the collection from Magnetic Island, Queensland. Another, 25 mm. h.d. was taken with a seine in shallow water on the mud flats, S.W. of Vanderlin Island, Sir Edward Pellew Group, Gulf of Carpentaria.

SALMACIS SPHAEROIDES (*Linné*).

There is a single specimen, 64 mm. h.d., from Magnetic Island, Queensland, and one specimen 74 mm. h.d. from the Sir Edward Pellew Group, Gulf of Carpentaria; the last was taken with a seine net in shallow water on the mud flats southwest of Vanderlin Island.

TEMNOTREMA PHOENISSA[2] *sp. nov.*

Test 6.5 mm. in diameter and 3 mm. high, with the actinostome 3.25 mm. across, the abactinal system 2.5 mm. and the periproct about 80 mm. In both ambulacral and interambulacral areas there are 11 or 12 coronal plates in each column. The inter-ambulacra are a little over 2 mm. wide at the ambitus and the ambulacra measure a trifle less than 2 mm.; the general impression is that ambulacra and interambulacra are of about equal width. The pits in the interambulacra are large, but

[2]Gr. Φοίνισσα = purple-red.

seldom longer than the space between the two of a pair ; they are rather shallow and ill-defined at the ambitus, but are much better defined dorsally. In the ambulacra they are smaller but still quite conspicuous. Typically, each coronal plate, in both interambulacra and ambulacra,

Fig. 1.

Temnotrema phoenissa, sp. nov. × 10 diameters.

carries a primary tubercle of moderate size near its centre, or, in the ambulacra, nearer the outer margin, and on each lower corner a small secondary tubercle.

In the ambulacra, owing to the narrowness of the plate and the space occupied by the pores the outer one of these secondary tubercles is almost directly beneath the primary. There are thus nominally three series of tubercles in each half of each area, but owing to the very poor development of the secondaries, only the primary series is at all easily seen, even with a lens.

Abactinal system large and conspicuous. Genital plates in close contact, shutting out all the oculars from the periproct, as usual in the Temnopleuridae; each genital has a very conspicuous pore in its distal half, and 2 or 3 well-marked secondary tubercles on its proximal margin, but there is no transverse line or groove; madreporite little larger than the other genitals, with 25-30 pores. Ocular plates wider than high, with a conspicuous pit or furrow along the proximal side, a secondary and 2 or 3 miliary tubercles distal to this furrow, and a small pore distal to the secondary tubercle. Poriferous areas narrow, nearly vertical, with very small pores. Periproct covered with a number of plates some (perhaps many) of which are now missing; it is evident that the plates were not approximately equal in size, but on the other hand it is equally clear that there was no suranal occupying more than half the area; the anus is undoubtedly excentric.

Actinostome large, with its membrane perfectly bare save for the five pairs of buccal plates, each of which carries a tube-foot; these plates are small and well separated from each other, so the distance between two pairs is not much greater than that between the two plates of a pair.

Primary spines from a millimetre to a millimetre and a half long, rather stout basally, but the distal third (or sometimes more) is abruptly smaller; abactinally the spines have their tips truncated with a sharp central thorn, but actinally the tips of the spines are rounded and the central thorn is scarcely or not at all evident. None of the spines are thorny or at all capitate. The only pedicellariae observed were the rather large but not distinctive ophicephalous ones; on the abactinal surface these have the valves red-purple, but actinally they are colourless.

Colour dull purplish-red with the inter-radial areas, abactinally, distinctly dull purple, though not in marked contrast. Primary (and other) spines bright red with more or less of their tips white.

Holotype, Reg. No. J. 4644, Australian Museum. Taken from coral, in company with *Parasalenia*, in 8 fms. off Ellison Reef, outer Great Barrier Reef, Queensland.

This is a very pretty but perplexing little sea-urchin, nearly related to *T. sculpta*, but with larger pits, different genital plates and a totally different colouration. Possibly more abundant material may show it is only a colour form of that species, but at present one would not be justified in calling this specimen *sculpta*. The difference from *maculata*, *scillae* and *siamensis* are equally evident, and the two Hawaiian Islands species are even more different. Hence it must, for the present at least, carry its own name. The conspicuous genital pores would seem to

indicate maturity in spite of the small size. The genus *Temnotrema* was not hitherto known from south of the Torres Strait region.

The drawing is by Miss Joyce K. Allan.

PARASALENIA GRATIOSA *A. Agassiz.*

There are two very small specimens of a *Parasalenia* in the collection which are almost certainly this species, though they are obviously too young to make the specific identification certain. One is 8 mm. long by 6.5 mm. wide and its primary spines are 6 mm. long; the other is only 3.5 mm. long, almost 3.5 mm. wide, and its primaries are 4 mm. long. These specimens were secured with the new *Temnotrema* from coral, in 8 fms., off Ellison Reef, outer Great Barrier Reef, Queensland.

ECHINONEUS CYCLOSTOMUS *Leske.*

There are two specimens of this tropicopolitan species at hand; one, 31 mm. long, by 24 mm. broad and 14 mm. high, was collected at Coates Reef, outer Great Barrier Reef, Queensland, and the other, 30 x 22 x 15.5, was taken at Feather Reef, also on the outer Great Barrier between 17° to 19° S. lat. These records extend the southern range of the species very considerably.

MOIRA STYGIA *A. Agassiz.*

There is a superb specimen of this remarkable spatangoid at hand from Port Denison, Queensland, the first satisfactory record from the Australian coast, though I saw specimens in the Museum in Brisbane in 1913. The present specimen is 40 mm. long, 33 mm. wide and 32 mm. high; the rear end is markedly concave. The dense covering of slender spines is so smooth, it gives the animal a "silky" appearance and feeling. The colour is a bright light fawn.

Accompanying the specimen is a note saying that it was found "floating upon surface of water in Bowen Harbour, Pt. Denison, Queensland. Mr. Rainford says this form swims on surface by aid of paddle-like spines on ventral surface. It can't be sunk." It is highly improbable that this species is capable of swimming—no sea-urchin known does that (after metamorphosis)—but, like its very near relative *Moira atropos*, it lives buried in mud or soft sand. This particular specimen died and as decay set in and gases began to form within the body, its buoyancy increased until it rose to the surface where it was found. Naturally it "could not be sunk" as the gases which brought it to the surface prevented its again sinking. The paddle-like spines of the ventral side suggest the possibility of swimming, but although they occur in many spatangoids there is not the slightest evidence that they can be thus used. They are obviously useful in forcing a way into or through mud or soft sand.

HOLOTHURIOIDEA.

POLYCHEIRA RUFESCENS (*Brandt*).

The discovery of this interesting holothurian at the Frankland Group, Queensland, is noteworthy, for it was not previously known from south of Cape York. There are 3 specimens at hand, 1 with 17 and 2 with

18 tenacles each; they are very dark purple-brown and range from 55 by 6 mm. to 80 by 9 mm.

HOLOTHURIA EDULIS *Lesson.*

A small specimen in fair condition is at hand from 7 fms., on Surprise Shoal, about 18° S. lat., outer Great Barrier Reef, Queensland.

HOLOTHURIA IMPATIENS (*Forskål*).

There are 2 small, very dark individuals at hand without any specific locality. They are labelled simply "Great Barrier Reef," Queensland, and each measure 60 by about 15 mm.

HOLOTHURIA PARDALIS *Selenka.*

In all, five representatives of this species are in the collection, ranging from 23 to 32 mm. in width and from 55 to 78 mm. in length; they are all in fair condition. Four of them were obtained on the "Great Barrier Reef," Queensland, while the fifth came from the Frankland Group, Queensland.

HOLOTHURIA LEUCOSPILOTA (*Brandt*).

An unique individual occurs in the collection labelled as from "Great Barrier Reef," Queensland. The specimen is in fair condition and measures 29 by 71 mm.

A SUPPLEMENTARY LIST OF THE ECHINODERMS COLLECTED BY SURGEON LIEUTENANT-COMMANDER W. E. J. PARADICE, R.A.N., IN QUEENSLAND AND NORTH AUSTRALIA.

By

Frank A. McNeill, Zoologist and A. A. Livingstone, Assistant in Zoology, Australian Museum, Sydney.

(Plate xvii.)

The following list, with notes, is intended to supplement the preceding contribution on Echinodermata by Dr. H. Lyman Clark, and deals with the balance of the material of that group secured by Surgeon Lieutenant-Commander W. E. J. Paradice, R.A.N. in the waters of north and north east Australia. This section of the collection includes one hundred and ten specimens, representing twenty-six species which are contained in twenty-two genera. Only four of the species listed (representing three genera) are recorded by Dr. Clark in the preceding paper, but with the exception of a single example of one of these, the localities are additional.

Much of the material dealt with has been submitted to Dr. Clark for examination from time to time, and his ready assistance has enabled us to correctly determine those species not seen by him. We wish to tender our sincere thanks to this authority, on whose advice we acted in compiling the present list in order to make a complete record of the fine collection of Echinodermata gathered by Dr. W. E. J. Paradice.

CRINOIDEA.

Lamprometra gyges (*Bell*).

One dusky brown example (in spirit) of this species was secured in shallow water on a coral reef at Port Darwin, North Australia; its oral arms measure about 65 mm.

Oligometra carpenteri (*Bell*).

Two spirit examples, brownish ochre in colour, were taken at the Sir Edward Pellew Group in the Gulf of Carpentaria. They were found clinging to the stems of an alcyonarian (probably *Iciligorgia* sp.), no doubt obtained in deep water.

The single specimen in the Australian Museum has one oral arm 75 mm. in length; the duplicate specimen of the species is in the Museum of Comparative Zoology, Cambridge, U.S. America.

Comanthus annulatus (*Bell*).

One juvenile example of this species in the collection has the upper part of the oral arms and disc dark brown, the latter being lighter on the underside. The longest oral arm measures about 72 mm.

Locality.—From between 5 and 15 fathoms, off Ellison Reef, outer Great Barrier Reef; Aug., 1924.

This species is included by Dr. H. L. Clark in the main report immediately preceding these notes.

ASTEROIDEA.

Anthenea tuberculosa *Gray*.

One dry specimen from a coral reef pool at Thursday Island. R. = 62 mm. The species is well known from the region.

Astropecten monacanthus *Sladen*.

A single example from the tidal sand flats at Paradice Bay on North Island, Sir Edward Pellew Group, Gulf of Carpentaria.

R. = 37 mm. Superomarginals about 28. This species has not hitherto been recognised from northern Australia, though Döderlein says it is found "und bis Australien."

Linckia laevigata (*Linn.*).

Thirteen examples of this elegant blue species are in the collection from two localities on the Great Barrier Reef. These include three examples (R. = 104 to 108 mm.) from Young Reef, northern Great Barrier Reef, and ten examples (R. = 81 to 113 mm.) from reefs exposed at low tide on the outer Great Barrier Reef between 17° and 19° S. lat.

The species was found to be very common at these two localities, which are in an area apparently previously neglected in the literature of the form.

Oreaster gracilis *Lütken*.

One large dry specimen of this well known and conspicuous sea-star was secured on the tidal flats at Paradice Bay on North Island, Sir Edward Pellew Group, Gulf of Carpentaria. R. = 175 mm.

The interest of the acquisition is enhanced by some detailed colour notes of the species made in the field by Surgeon Lieutenant-Commander Paradice, supplemented by a colour diagram from the brush of the collector.

"*Aboral surface.*—With a fine mosaic pattern of white and olive green, the white predominating, but not occurring on the ridges between the tubercles. Tubercles orange coloured, tipped with yellow; their bases a hue half way between orange and olive green. Tips of rays yellowish orange. Madreporite yellowish orange with a centre of olive green.

"*Oral surface.*—White, with a creamish tinge and pale blue at the inter-radials around the mouth. Marginal spines white with an orange tinge. Tips of rays orange. Tube feet reddish brown, with orange suckers.

"Area between marginal tubercles of oral and aboral surfaces chrome green."

OPHIUROIDEA.

OPHIARACHNA INCRASSATA (*Lamk.*).

Three examples, with disc diameters 28 to 56 mm., from the following localities.—

In coral pools between tides on Ellison Reef, outer Great Barrier Reef (two examples).

In pool on coral reef, High Island, Frankland Group (one example).

This species is included by Dr. H. L. Clark in the main report immediately preceding these notes.

OPHIOLEPIS SUPERBA *H. L. Clark.*

Two specimens of this brittle-sea-star are in the collection, with disc diameters of 14 to 20 mm. They are from Sir Edward Pellew Group in the Gulf of Carpentaria, and on reef at Low [Woody] Island, off Port Douglas, Queensland.

OPHIARACHNELLA MARMORATA (*Lyman*).

In all, five specimens of this species were secured, two of which are now in the Museum of Comparative Zoology, Cambridge, Mass., U.S.A. The remaining three have disc diameters of 7 to 16 mm.

Localities.—Sir Edward Pellew Group, Gulf of Carpentaria (one specimen); Port Darwin, North Australia (two specimens out of a total of four previously in the Australian Museum collection).

OPHIARACHNELLA INFERNALIS (*Müller and Troschel.*).

There is one small representative of this species in the collection from Port Darwin, North Australia, with a disc diameter of 9 mm.

OPHIOCHASMA STELLATA (*Lütken*).

A solitary example of this pentagon-disced species was gathered on the reefs at Low [Woody] Island, off Port Douglas, Queensland. Disc diameter, 14 mm.

OPHIOTHELA *sp.*

After careful examination by Dr. H. L. Clark, numerous juvenile examples of this genus in the collection are considered to be probably referable to *O. danae* Verrill. They are undoubtedly *Ophiothela*, but are too immature for certain identification of the species.

Locality.—Sir Edward Pellew Group, Gulf of Carpentaria; found clinging to the stems of the same alcyonarian (? *Iciligorgia*) which harboured the examples of the crinoid *Oligometra carpenteri* (Bell) supra.

OPHIOPLOCUS IMBRICATUS (*Müller and Troschel.*).

Two examples of this form in the collection are from Sir Edward Pellew Group, Gulf of Carpentaria. One of these is now in the Museum of Comparative Zoology, Cambridge, U.S.A.; the remaining specimen measures 14 mm. across the disc.

OPHIACTIS SAVIGNYI (*Müller and Troschel.*).

A total of ten specimens of this species was obtained; three of them are now in the Museum of Comparative Zoology, Cambridge, Mass.,

U.S.A. The balance of specimens before us have disc diameters ranging from 5 to 8.5 mm.

Localities.—Port Darwin, North Australia (9 specimens); from pores of sponge taken from the railway pier at the same place (one damaged specimen).

Ophiothrix longipeda (*Lamk.*).

Six well preserved specimens of this curious form occur in the collection, one of this total being now in the collection of the Museum of Comparative Zoology. The disc diameter of the five remaining examples before us ranges from 10.5 to 20.5 mm. in their present contracted condition. One long arm of the largest example measures approximately 460 mm.

Localities.—Amongst coral on reef at High Island, Queensland, 17.7.1924 (two specimens); Sir Edward Pellew Group, Gulf of Carpentaria (one specimen); Port Darwin, North Australia (three specimens, two of which were secured in the pores of the same sponge as the damaged specimen of *Ophiactis savignyi* (supra)).

Ophiothrix stelligera *Lyman.*

There is one dry individual species in the collection with unusually long arm spines. Disc diameter 6 mm.

Locality.—Port Darwin, North Australia.

Ophiothrix smaragdina *Studer.*

A unique dry example of this species is in the collection from Port Darwin, and has a disc diameter of 15 mm.

Ophiothrix martensi australis *H. L. Clark.*

In all, three examples of this form were collected, one of which is now in the possession of the Museum of Comparative Zoology, Cambridge, Mass., U.S. America. The two specimens before us have disc diameters of 5 and 10 mm.

Locality.—Port Darwin, North Australia.

ECHINOIDEA.

Peronella lesueuri (*Agassiz*).

One small adult specimen (bare) of this species measures 72 x 67 mm., and was secured on a tidal flat at the south west of Vanderlin Island, Sir Edward Pellew Group, Gulf of Carpentaria; 26 May, 1923.

Another smaller specimen (bare), with apical disc wrecked, and measuring 40 x 36 mm., can be referred only doubtfully to this species, which it appears to approach more closely than others. It was collected on Oyster Cay, Great Barrier Reef, Queensland.

A third specimen (bare) measuring 28 x 25.5 mm. is probably a young *lesueuri*, but is too much damaged to make identification certain. This specimen was collected with a series of the next species listed (*P. orbicularis*), all being washed up on the shore of Paradice Bay, North Island, Sir Edward Pellew Group, Gulf of Carpentaria.

PERONELLA ORBICULARIS (*Leske*).

A series of six examples of this species measuring 23.5 x 23 to 32 x 30 mm. are bare and bleached, but quite typical of the form. They were found washed up on the shore of Paradice Bay, North Island, Sir Edward Pellew Group, Gulf of Carpentaria. Two of the series are now in the Museum of Comparative Zoology, Cambridge, Mass., U.S. America, the balance being stored in the Australian Museum.

The species is already known from the above region.

LAGANUM DEPRESSUM *Agassiz*.

Eight examples in the collection, ranging from 38.5 x 51 to 57.4 x 71.5 mm., agree perfectly with the characters given by H. Lyman Clark in his keys to the Laganidae and to the genus *Laganum*[1]. They were collected alive on a sand flat at low tide—Low [Woody] Island, off Port Douglas, Queensland.

Judging from the number of representatives of this species in the collection of the Australian Museum, it appears to be a very common inhabitant of the Queensland coast.

ARACHNOIDES PLACENTA (*Linn.*).

Two specimens (bare) of this form were secured on a tidal flat at the southwest of Vanderlin Island, Sir Edward Pellew Group, Gulf of Carpentaria. They measure 61 to 69 mm., one of the examples is now in the collection of the Museum of Comparative Zoology, Mass., U.S. America.

Seven specimens (collected alive) on a tidal sand flat in Paradice Bay, North Island, Sir Edward Pellew Group, Gulf of Carpentaria, measure 38 to 49 mm. Two of these examples are now in the collection of the Museum of Comparative Zoology, Mass., U.S. America.

Another wrecked specimen (bare) measures approximately 60 mm., and was found washed up on the shore at Paradice Bay, North Island, Sir Edward Pellew Group, Gulf of Carpentaria.

The species is known from the regions indicated.

MARETIA OVATA (*Leske*).

This well known and delicate-spined Queensland species is represented in the collection by five examples (48 x 39 to 50 x 43 mm.) secured alive by dredging in 15 fathoms amongst seaweed on a sandy bottom—Northeast Bay, Great Palm Island, near Port Denison, Queensland.

Another bare test measuring 61 x 52 mm. was secured on Oyster Cay, Great Barrier Reef, Queensland.

TRIPNEUSTES GRATILLA (*Linn.*).

Three examples of this typical Queensland form (69 to 110 mm., not including spines) were secured alive at High Island in the Frankland Group, Great Barrier Reef, Queensland; the two smaller specimens from the lagoon sand flats at low tide, the larger from a sandy bottom pool on 15.7.1924.

Three bare tests of the same species (85 to 113 mm.) were also collected on the reefs at Low [Woody] Island, off Port Douglas, Queens-

[1]Clark—Mem. Mus. Comp. Zool., xlvi, 1, 1914, pp. 44-45.

land. One of these is now in the Museum of Comparative Zoology, Mass., U.S. America.

ECHINOMETRA MATHAEI (*Bl.*).

(Plate xvii).

Several specimens of this form were collected at the localities enumerated below. The species occurs abundantly throughout the regions indicated.

Sir Edward Pellew Group, Gulf of Carpentaria.—One typical adult (36 x 32 mm., exclusive of spines).

Pearce Island, Queensland.—One bare test 61 x 49 mm.

Low [Woody] Island, off Port Douglas, Queensland; reefs.—two bare tests 56 x 46 to 67 x 56 mm., and one adult 38 x 49 mm. exclusive of spines.

Frankland Group, Great Barrier Reef, Queensland; from burrows in dead coral on the reefs.—one half grown and three typical adults with test measurements ranging from 37 x 26 to 57 x 48 mm.

Some interesting notes on the habits of this species at Lord Howe Island in the South Pacific were made by Ramsay,[2] and later supplemented by the late Allan R. McCulloch,[3] who observed the destructive effect of the urchin on the local clams. Quite recently Mr. A. Musgrave has visited the same island and verifies the former observations with the fine photograph which appears on Plate xvii. He remarks " In the flat coral rock at the back of the reef we came across clams. These were babes in size when compared with the big ones which flourish among the reefs of New Guinea and the Queensland coast; eight inches is the maximum length of the Lord Howe Island species, *Tridacna maxima*, var. *fossor*. They do not exist on the outer edge of the reef, being driven back as a result of the presence of the purple-spined sea-urchin *Echinometra mathaei*, which, like others of its kind, has the habit of tunnelling in the coral rock. Should a clam by any chance lie in the path of a tunnelling urchin it may ultimately be dislodged, and if swept by the waves into a sandy pool—dies."

CENTRECHINUS SETOSUS (*Leske*).

We refer to this species two adult specimens (tests 65 and 103 mm.) which were secured alive in a reef lagoon at Russel Island, Great Barrier Reef, Queensland.

The specimens have spines with a decided reddish brown tinge, and the cuticle on the inter-ambulacral plates of the aboral surface has light whitish patches.

Two bare tests (57 and 69 mm.) were also collected on the reefs at Low [Woody] Island, off Port Douglas, Queensland. One of these tests is now in the Museum of Comparative Zoology, Mass., U.S. America.

The form is well known from the regions indicated above.

A record of the species is also included by Dr. H. Lyman Clark in the main report immediately preceding this paper.

[2] Ramsay—Australian Museum Memoir ii, 1889, p. 37 (as *Echinometra lucunter*, Leske).

[3] in Hedley—Rec. Austr. Mus., xiii, 4, 1921, p. 171 (as *Echinometra lucunter*).

CENTRECHINUS SAVIGNYI (*Michelin*).

Two dark purple specimens (69 and 102 mm.) are referred to this species. The larger example has some of the short oral spines greenish brown at their bases, but the brownish hue of the longer of the fine secondary spines on the test is considered to be due to the dissolving properties of the alcohol fixative used in the killing of this now dry specimen.

Locality.—Russel Island, Great Barrier Reef, Queensland; in reef lagoon.

A record of this species is also included by Dr. H. Lyman Clark in the main report immediately preceding this paper.

EXPLANATION OF PLATE XI.

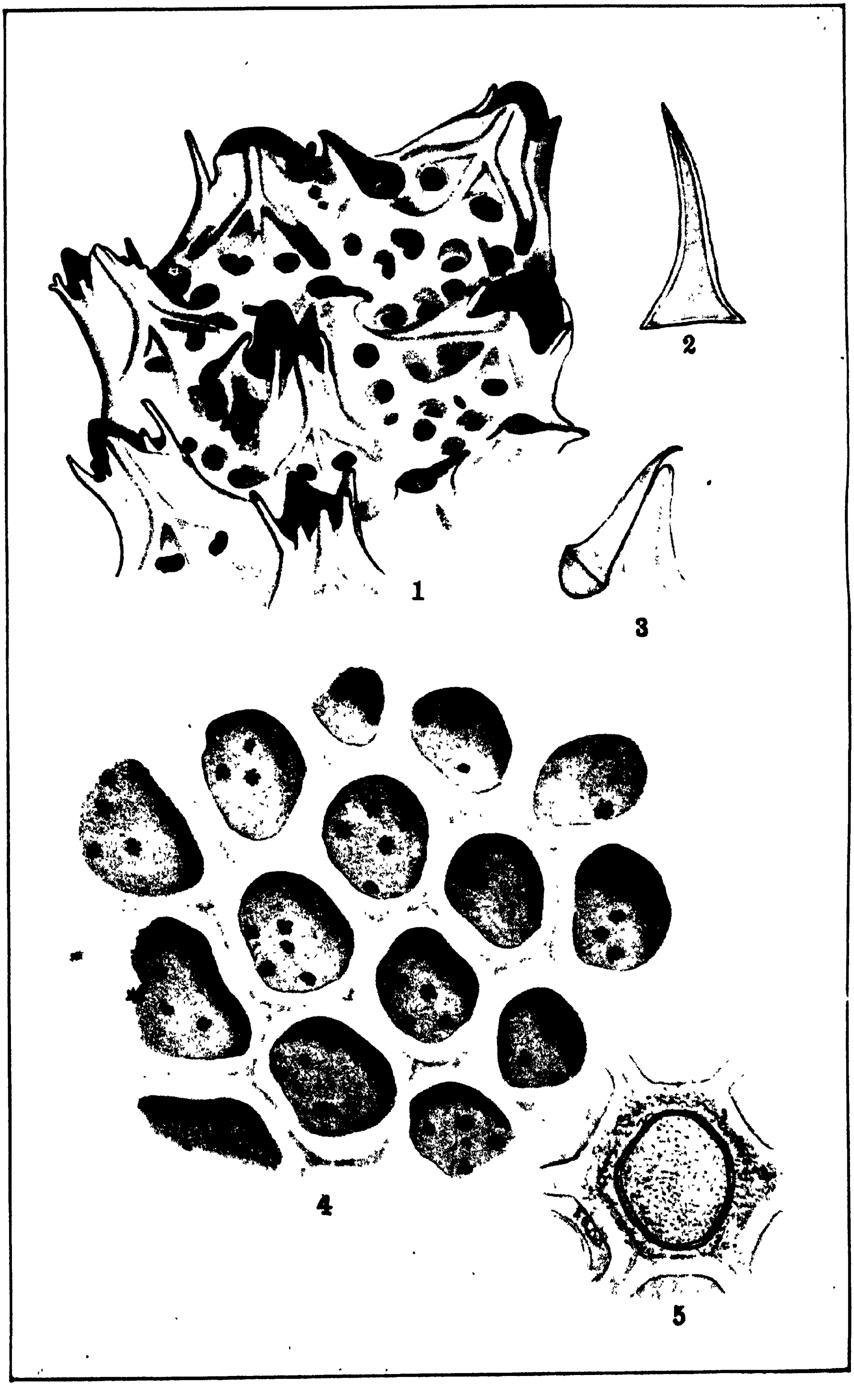
Fig. 1. *Escharoides larvalis* (MacGillivray). A portion of an incinerated colony.

,, 2. *Escharoides larvalis* (MacGillivray). Mandible of a zooecial avicularium.

,, 3. *Escharoides larvalis* (MacGillivray). An avicularium on a mucronate process. Such structures are present on the frontal zooecial walls.

,, 4. *Escharoides larvalis* (MacGillivray). A portion of a colony with the basal zooecial walls removed to show the structure of the underneath surface of the frontal zooecial walls and the contained foramina or pores. The zooecial apertures cannot be seen in such a view.

,, 5. *Escharoides larvalis* (MacGillivray). View of the outside of a basal zooecial wall. This is the surface which adheres to the weed, or rock, or whatever the colony is attached to.



EXPLANATION OF PLATE XII.

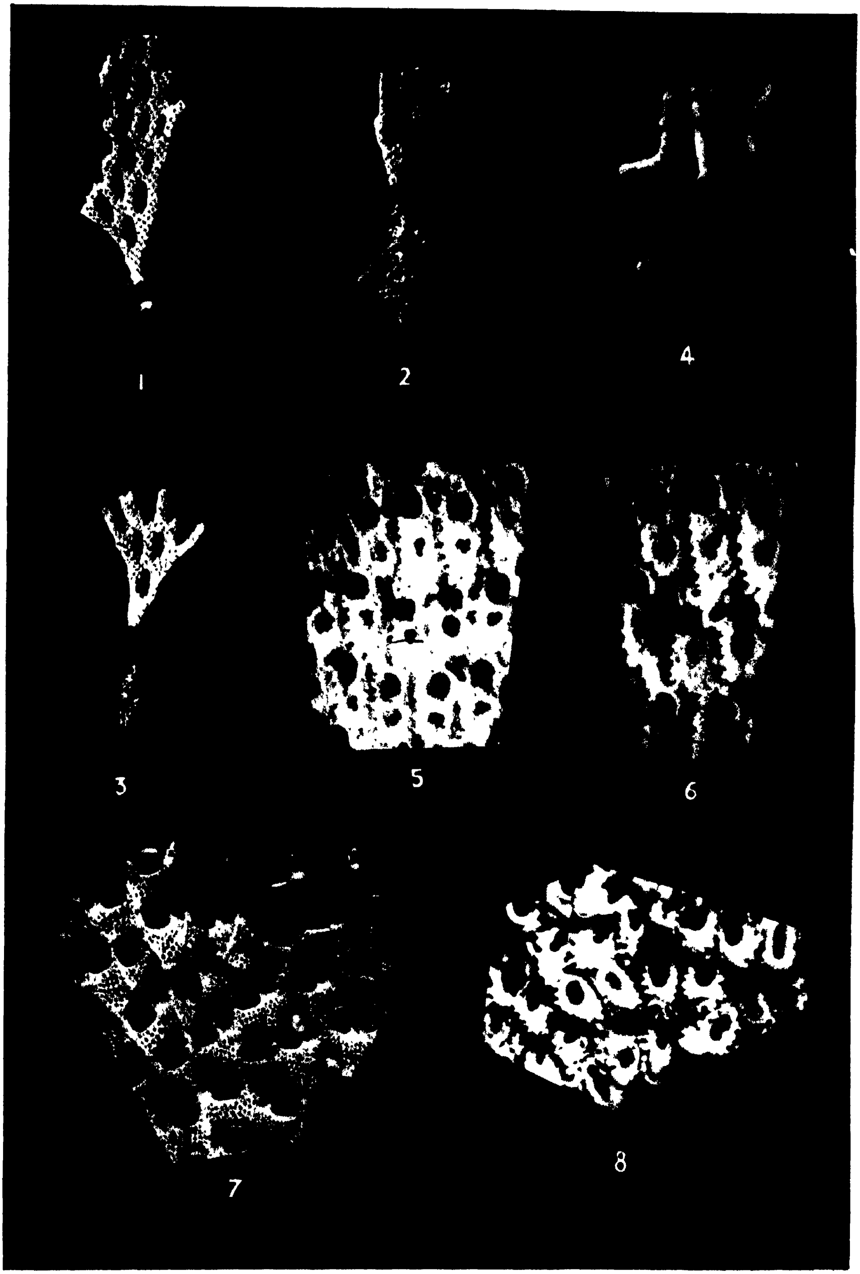
Figs. 1-3. *Petralia undata* MacGillivray. Colonies with filaments, by means of which they anchor themselves in the soft sand on the sea floor.

,, 4. *Haswellia coronata* Reuss. A colony with anchoring filament which serves as a means of attachment to the sea bottom. The filament arises from the central column, which is thought to be hollow.

,, 5-6. *Lepralia mucronata* var. *celleporoides* Busk. Views of incinerated portions of a colony.

,, 7. Zooecial detail of *Lepralia uniturrita* sp. nov.

,, 8. Zooecial detail of *Lepralia bicornis* Thornely.



G. C. CLUTTON. photo.

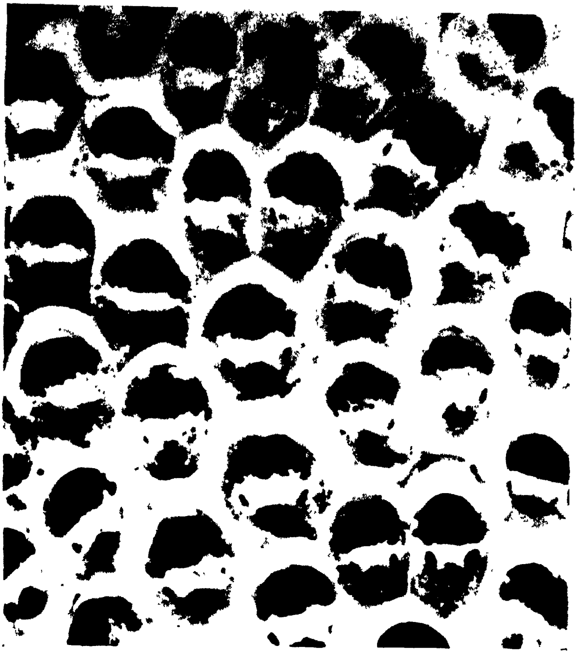
EXPLANATION OF PLATE XIII.

Fig. 1. Enlarged zooecial detail of *Steganoporella greavesi* sp. nov.

,, 2. Zooecial detail of same.

,, 3. View of portion of a colony of *S. greavesi* sp. nov. with basal wall removed, showing the polypide tube of each zooecium.

,, 4. Zooecial detail of *Arachnopusia acanthoceros* (MacGillivray), showing only the first or basal section of the spines.



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I. C. CLUTTON, photo.

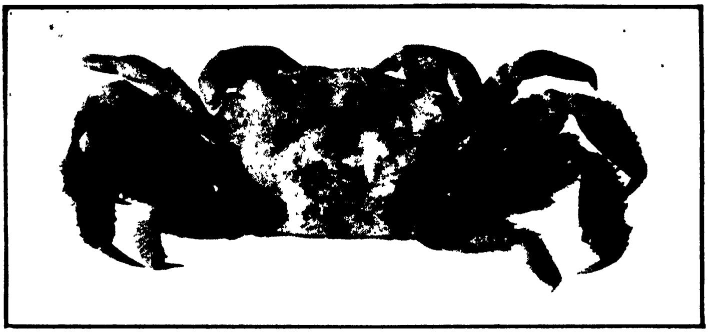
EXPLANATION OF PLATE XIV.

Cleistostoma wardi, sp. nov. Male paratype. Carapace 16.6 mm. wide.

Fig. 1. Dorsal view.

,, 2. Ventral view showing chelae.

,, 3. Ventral view showing abdomen.



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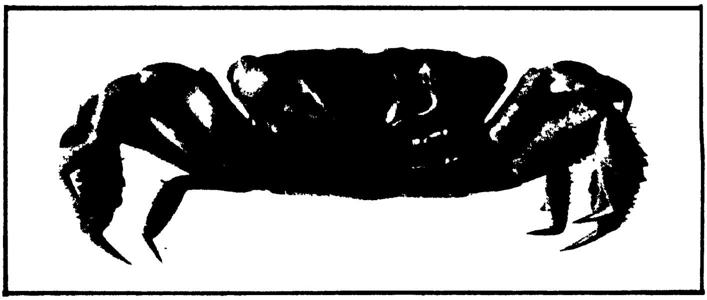

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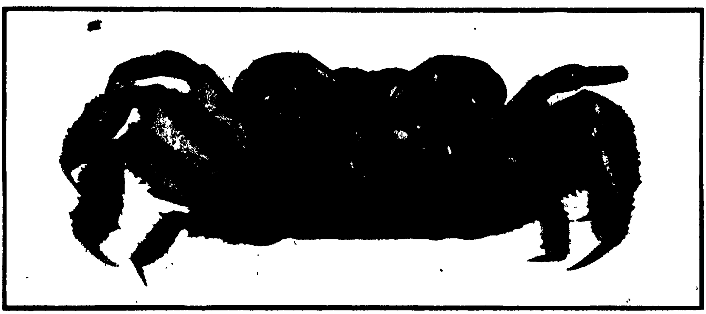

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C. R. SHOEMAKER, photo.

EXPLANATION OF PLATE XV.

Cylindrotelphusa wakipensis, sp. nov. Female holotype. Carapace 31.6 mm. wide.

Fig. 1. Dorsal view.

,, 2. Front view.

,, 3. Ventral view, showing chelae.

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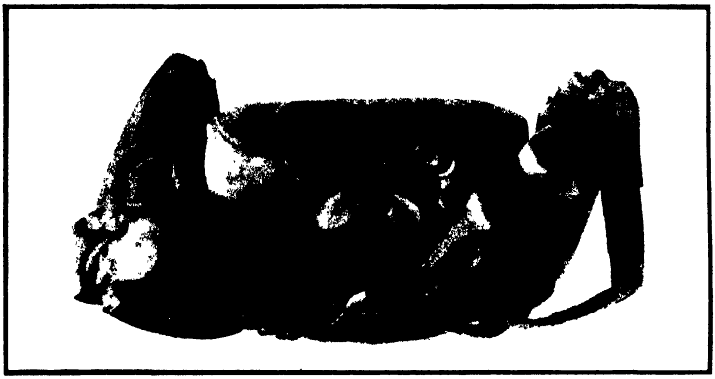

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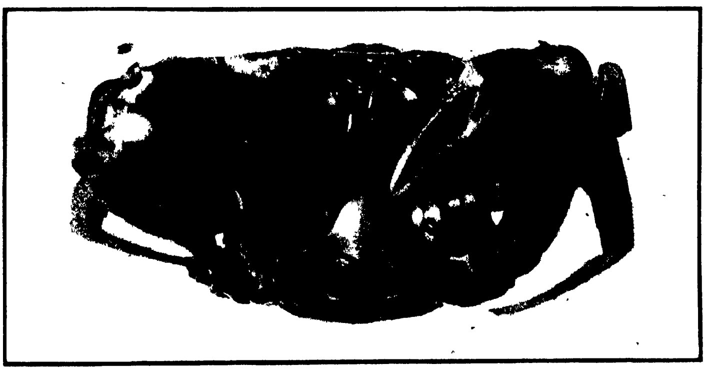

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C. R. SHOEMAKER, photo.

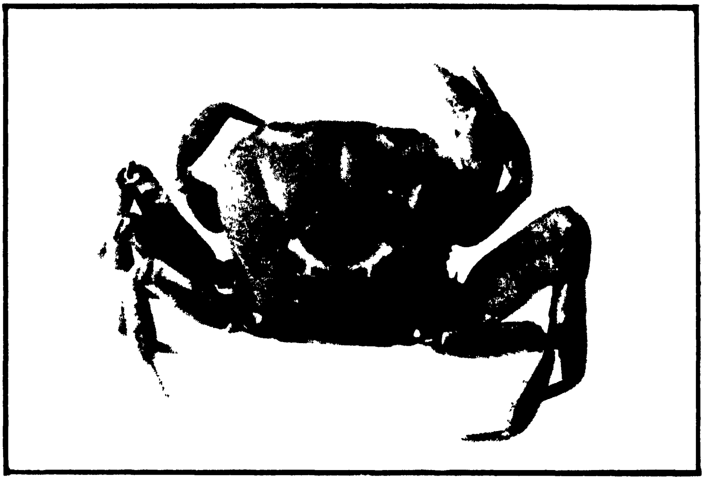
EXPLANATION OF PLATE XVI.

Parathelphusa (*Liotelphusa*) *briggsi*, sp. nov. Male holotype. Carapace 17 mm. wide.

Fig. 1. Dorsal view.

,, 2. Front view.

,, 3. Ventral view.



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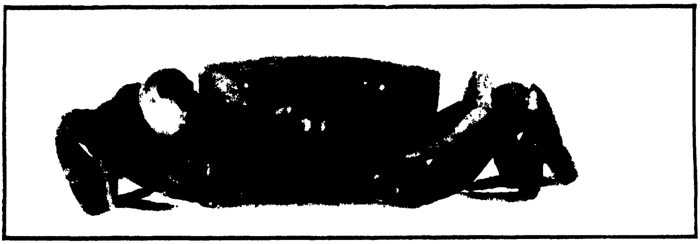

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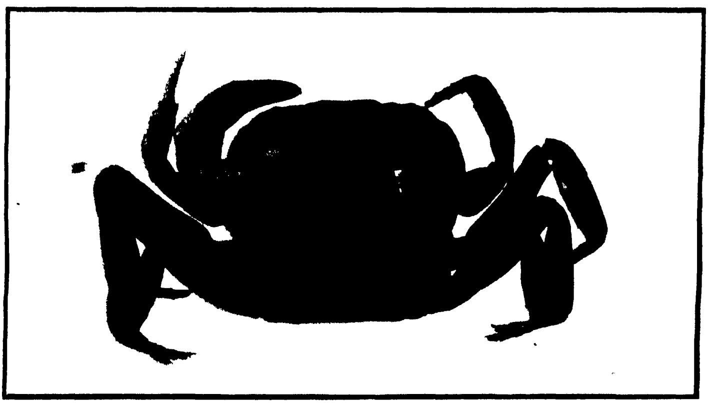

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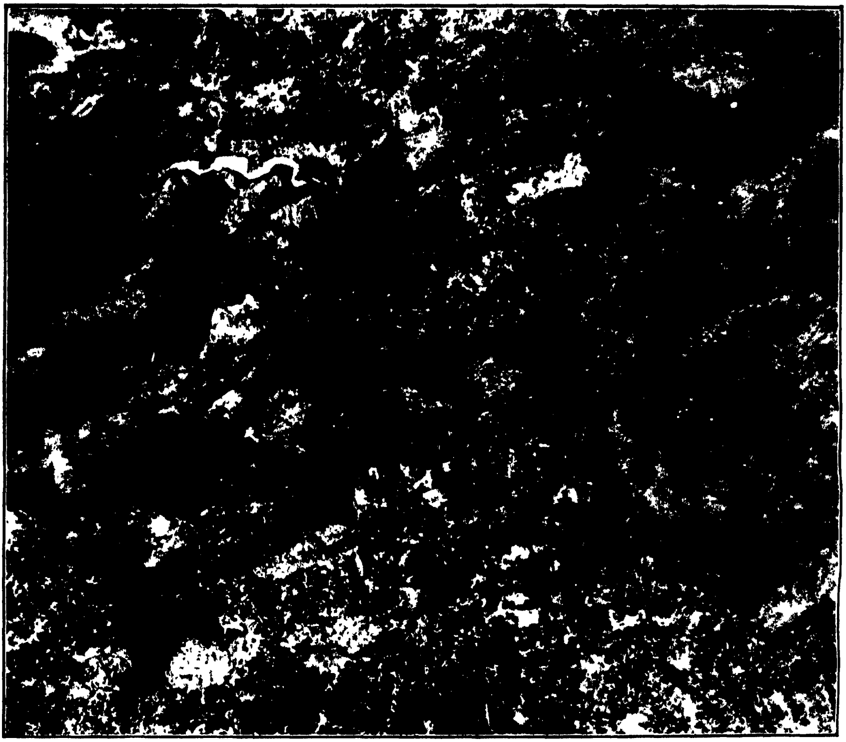
C. R. SHOEMAKER, photo.

EXPLANATION OF PLATE XVII.

A section of the outer edge of the coral reef flat at Lord Howe Island, three hundred miles east of Port Macquarie, New South Wales, showing numerous individuals of the sea-urchin, *Echinometra mathaei* (Bl.). The channel-like tunnels formed by this species are plainly discernible; some of them may be noticed near the clam in the background (page 198).



ANTHONY MUSGRAVE, photo.

CONTRIBUTIONS TO THE CRANIAL OSTEOLOGY OF THE FISHES.

Nos. III., IV. and V.

By

H. Leighton Kesteven, D.Sc., M.D., Ch.M.,
Honorary Zoologist, Australian Museum.

No. III. The Teleostome Skull; an Attempt to provide an Ichthyo-craniological Nomenclature.

The several skulls described in these communications were dealt with as they came to hand and not in any prearranged order. As the work progressed, the disability of the want of a recognised terminology for the various skull areas and cavities was increasingly felt. When a number of skulls had been described it was found that similar areas or cavities were not always similarly constituted in the different skulls. Two illustrations may be cited. There are at the back of all the skulls described three muscle fossae on each side. Of these, that which is next the mid-line appears to be constantly related to the most anterior epiaxial capiti-nuchal muscles; the middle fossa on each side appears equally constantly to be developed for the attachment of the anterior hypoaxial capiti-pectoral muscles, whilst the relation of the third fossa to the dilatator operculi muscle gained it the name of *dilatator fossa* from the pen of Sagemehl and Allis.[1] The three fossae are developed in very different degrees and constituted differently in different fish. Again, the various bony recesses for the parts of the auditory organ are not constantly accommodated in the same bones, yet the cavities themselves are constantly recognisable.

To obviate this disability a halt was called in the description of the skulls and the following general description of a fish skull was drawn up. It will be noted that this description is, for the most part, based on the form and constitution of the adult skull, without reference to the nature, covering, or origin of the constituent bones. Where suitable designations have been already used they have been availed of; in the absence of such, topographical terms have been applied in most instances, in preference to anatomical terms which imply relation to soft parts.

General Description.

The cranium of the bony fishes presents three very readily recognisable regions; placed in line in front of one another, they are the *cerebral, orbital,* and *ethmo-nasal* or *preorbital* regions.

The nasal capsules are very incomplete, and the bones related to them are the premaxillae below, the mesethmoid behind, and the nasals above. Usually the premaxillary labial is also related to the capsule,

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[1] See papers cited on pages 184 and 186.

and in some forms the anterior suborbital scute and the maxillary labial also share in providing bony protection for the organ. The prefrontal bone commonly shares in forming the hinder wall.

The orbital region is roofed by the frontal bones and is further protected in front and above by the prefrontal. A postfrontal is not commonly developed above behind, and the posterior wall is more or less completed by the anterior bones of the cerebral region. An orbitosphenoid, which may be fused with its fellow of the opposite side, may or may not be developed between the two optic capsules. In the absence of the orbitosphenoid the interorbital septum may be wholly membranous, or partly membranous and partly cartilaginous. Inferiorly the orbital region is strengthened by the synpterygoid, which extends forward under the premaxilla and backward under the basioccipital.

The cerebral region comprises the cavum cerebri and the otocrane. Neither of these capsules are complete, but, as it is the inner wall of the octocrane and a precisely corresponding portion of the outer wall of the cavum cerebri which are wanting, the deficiency is to be seen only from within the cranial cavity. This deficiency may be designated the lateral cranial fenestra. The bones which enter into its formation will be dealt with seriatim later, and we proceed to the description of the general features of this region. The shape of the conjoined cerebral and otic cavities is exceedingly variable; it may be almost cubical, nearly round, or flattened from side to side or dorso-ventrally. An occipital crest is very generally developed along the central dorsal line, projecting beyond the cranium posteriorly. On either side of this crest, in the upper part of the posterior aspect of the cranium, there is always defined an *occipital groove* or *fossa*. The outer boundary of this fossa is usually a ridge or flange developed on the epiotic bone; dorsally this boundary inclines toward the midline, and its real or imaginary continuation thereto constitutes the dorsal limit of the fossa. Inferiorly the fossa may not be defined, or its boundary may, as in *Platycephalus*, be determined by flanges from certain of the bones on the back of the cranium.

Allis[2, 3] has designated this occipital fossa "supra-temporal groove" in *Scomber* and "subquandrangular groove" in *Scorpaena*. Neither of these designations appears happy; the latter is emphatically not of general application, and by no stretch of the imagination could one justify the term supratemporal as applied to the occipital fossa of such forms as *Platycephalus*.

Lateral to the occipital fossa is the *temporal fossa*. The medial boundary of this is the lateral boundary of the other fossa; toward its dorsal limit this boundary inclines forward to meet the dorsal end of the pterotic process, which always forms the anterior or lateral boundary of the temporal fossa. Like the occipital, this fossa may be quite open and undefined below, or may be defined by the development of outstanding flanges of the bones of the back of the cranium.

The designation is here adopted from Allis (l.c.) after Sagemehl.

[2]Allis—Jour. Morph., xviii, 1903, pp. 45-328.
[3]Allis—Zoologica, 1910, Heft. 57, pp. 1-219.

The *dilatator fossa* is another constantly present muscle fossa on the side of the cerebral region of the skull. It will be found between the pterotic process and the posterior wall of the orbit. At times quite a little pit, it may in other forms, for example *Cheilodactylus*, assume a considerable size. Here again my designation is adopted from Allis after Sagemehl. Ridewood[4] termed this the lateral temporal fossa; if a purely topographical term is to be applied, *postorbital* would be preferable.

Turning our attention next to the base of the cerebral portion of the skull, the saccular cavities frequently bulge out so prominently that they call for special designation. They have been termed the "bullæ" by writers on ichthyo-craniology. The term is misleading and needs qualification; if they be designated *saccular bullæ* ambiguity will be avoided.

At the side of the skull the external aperture of the foramen trigemino-facialis is more or less completely covered by a broader or narrower arch of bone. The little cave which is thus formed on the side wall of the skull has been designated the *trigemino-facialis chamber* by Allis, and, though it is extremely doubtful whether all that he claims for the significance and homologies of the feature will stand the test of further examination, the constancy of the structure justifies the retention of his term.

The dorsal and ventral lines of the skull need no definition, but attention must be drawn to the fact that the latter is very frequently not parallel with the basicranial axis, owing to the presence of the myodome below the floor of the cerebral cavity. The ventral plane of the skull, with rare exceptions (for example in *Hippocampus*) corresponds with the axis of the body, and the angle between this line and the basicranial axis would appear to vary without any correlative features, and its variations to be devoid of taxonomic or comparative-morphological significance.

The two facets developed so commonly on the exoccipital bones for articulation with the first neural arch will be designated the *neural facets*.

Within the cranial cavity where are several more or less constantly recurring features which are deserving of recognition with proper names.

The cranial floor presents *occipital, mesotic, preotic,* and *prepituitary* segments. The occipital segment is constituted by the *horizontal* laminae of the exoccipital bones or by the dorsal surface of the basioccipital. The mesotic segment lies between the otic capsules; commonly it presents a more or less extensive *basicranial fenestra* in its posterior portion. This fenestra, when present, is due to the approximation of the cava sacculi to the mid line beneath the cranial cavity, and is made good by a horizontal extension of the membranes which close the lateral fenestrae, *membrana obturator basicranialis*. So much of the mesotic segment of the floor as is bony is constituted by portions of the horizontal laminæ of the prootic bones. The prootic segment of the floor lies in front of the otic capsules and behind the fenestra hypophysios or sella turcica; it is constituted by the anterior median portion of the

[4]Ridewood—Jour. Linn. Soc. (Zool.) xxix, 1905, p. 260.

horizontal laminæ of the prootic bones. The prepituitary segment is constituted by the basisphenoid, when that bone is present.

The *azygos sinus* is a little conical pit very constantly present on the dorsal aspect of the basioccipital bone just in front of the condyle; it is widest above and slopes down and backward to terminate in front of the centre of the depth of the condylar cavity, being separated therefrom by a thin partition of bone only. This pit may be roofed by the horizontal laminæ of the exoccipital bones, or the suture between these laminae may be interrupted so that the azygos sinus appears as a fossa on the floor of the occipital segment of the cranial floor. This sinus was designated "cavum sinus imparis" by Sagemehl[5] in his descriptions of the crania of the Characinidæ and Cyprinidæ, and his designation is adopted by Allis in his work on the Mail-Cheeked Fishes.[6] In the forms which Sagemehl studied, the sinus is roofed more or less completely so that it may appositely be termed a cave, not so however in many other forms. Rarely the sinus is divided more or less completely by a central transverse partition; these facts lead me to discard "cavum" and to adopt "azygos" in preference to "imparis."

The extent of the *lateral cranial fenestra* is variable in respect of its height; it may or may not reach the roof of the cranial cavity. Whether or no the fenestra reaches the roof, the cranial wall is by it divided into *postotic* and *preotic* areas. The designations opisthotic and prootic are deliberately avoided to prevent implicating the bones. In certain fishes, as for instance *Cheilodactylus*, the posterior attachment of the *lateral obturator membrane* of the cranial cavity is so far back that the postotic cranial wall is very narrow in its upper part and occupies the transverse plane of the head. It might appear that under such circumstances it were well to designate this wall "occipital" or "posterior," but there are many forms in which there is no posterior wall, the side wall sloping slowly to the upper margin of the foramen magnum. In such forms the postotic wall, in the sagittal plane, arches toward the midline in such manner that it were a purely arbitrary procedure to define wall from roof, for example, in *Platycephalus* and *Epinephelus*. In the great majority of cases the postotic cranial walls (and roof) are constituted entirely by the vertical laminae of the exoccipital bones, but exceptionally small areas of the epiotic and supraoccipital share in its formation.

The *preotic* cranial wall is bulged out laterally to form the *temporal* and *trigemino-facialis* fossæ. The latter are situated on either side of the prepituitary and prootic segments of the floor, with the temporal fossæ above and in front of them.

The *lateral cranial fenestra* exposes to view all the cavities in the outer wall of the otocrane. The *posterior ampullary fossa* is lodged to the outer side of the anterior margin of the postotic wall, that margin actually forming its medial lip, just above the level of the cranial floor. The *anterior ampullary fossa* is situated in front of the posterior at a slightly higher level. The *posterior semicircular bony canal* rises through the substance of the epiotic bone towards the roof at an angle of about

[5] Sagemehl—Morph. Jahrb., x, 1885, pp. 1-119; *ib.*, xvii, 1891, pp. 489-595.
[6] Allis—Zoologica, Heft. 57, 1910.

forty-five degrees with the sagittal plane. The *horizontal canal* connects the depths of the two ampullary fossæ. The two ampullary fossæ may or may not be separated by a quite appreciable interval, and this interval would appear to be constantly covered by cartilage. In front of the anterior ampullary fossa there is an *arcuate recess* whose higher limit is above, and whose lower limit is below, and it may be actually underneath the fossa. The axis of this recess is approximately at an angle of forty-five degrees with the sagittal plane and therefore at right angles to the posterior semicircular canal. The lower portion of the recess may be divided from the upper by a low shelf. This recess would appear to have been developed in relation to the anterior semicircular canal and its ampulla, but so far as my dissections have gone I have always found that canal lying to the inner side of the recess and not within it. The *cava sacculorum* lie below the ampulary fossæ, and may extend above or below the level of the cranial floor.

The anterior cranial wall is in part bony and for the rest membranous. I have in a previous contribution[7] adopted Gaupp's term *membrana spheno-obturatoria*[8] to apply to this membranous portion of the anterior wall of the cranial cavity of many of the fishes, birds, and reptiles in the adult condition, and practically all crania in early stages of development. In the absence of a basisphenoid there is no distinction between the lower end of the sphenoidal obturator membrane and the prepituitary segment of the cranial floor.

On the cranial roof there is not uncommonly an area of cartilaginous "ceiling." This ceiling is situated around the forward end of the supra-occipital bone and the hinder ends of the frontals. Swinnerton[9] describing the development of *Gasterosteus* wrote :—"The supra-occipital is an unusually large bone. Anteriorly it seems to partially separate the frontals ; in reality it extends under them almost to the level of the outstanding post-orbital process, and now *embraces the larger part of the epiphysial cartilage itself also.*" There can be little doubt that the cartilaginous ceiling so commonly present in the adult skull is the *epiphysial cartilage*, persistent in these forms. Accordingly it is so designated in the descriptions which follow.

The term "*eye-muscle canal*" will be discarded in favour of the later "*myodome.*" True, the former term has acquired an established meaning and general acceptance, but it does not admit of adjectival use, whilst the adjective "myodomial" lends itself to clarity and brevity of description of the parts of the various bones which enter into the composition of the myodome.

I have elsewhere[10] proposed the designation *sphenoidal cavity* for that anterior prolongation of the cranial cavity which, in certain fishes, accommodates the olfactory nerves.

It were, of course, beyond the scope of the present contribution to discuss the various modifications of the several bones which enter into the composition of the cranium, but certain of those bones present,

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[7]Kesteven—Jour. R. Soc. N.S. Wales, lix, 1925 (1926), pp. 108-123.
[8]Gaupp—Denkschr. Med. Ges. Jena, vi, 2, 1908, pp. 539-788.
[9]Swinnerton—Quart. Jour. Micro. Soc., xlv, 1902, p. 525.
[10]Kesteven—loc. cit.

more or less constantly, definite parts or processes the citation of which by pre-established designations will lead to brevity of description.

If we except the orbitosphenoid bone and the sphenoidal cavity, and one or two other very minor features, it may be said of the acanthopterygian skull that it presents all the features which are to be found in teleostean fishes, as well as some that are peculiar to the group. That being so, it is fitting that an attempt to establish a general nomenclature for the parts of the several bones of the fish skull should be based very largely on bones of the acanthopterygian skull.

The basioccipital bone presents *condyle* and *body*. The body may be excavated by a *saccular recess* on either side above, and a median *myodomial recess* below. The azygos sinus opens above in front of the condyle at the posterior end of the median ridge which is the roof of the myodomial recess. The outer walls of the saccular recesses may be known as the *lateral laminæ* of the bone. The *basal lamina* is that sheet of bone which forms the floor of the three recesses and appears on the ventral aspect of the cranium. This lamina is commonly deficient below the fore part of the myodomial recess, the deficiency being made good in the complete cranium by the hinder end of the synpterygoid.

The exoccipital bone bears the neural facet of its side supported on a more or less well developed *buttress*. The *superior vertical lamina* rises beside the foramen magnum, and commonly arches over it to meet its fellow of the other side. This lamina may occupy the sagittal or transverse plane or any position between them. The *inferior vertical lamina* sutures with the lateral lamina of the basioccipital, and forms the upper part of the outer wall of the saccular cavity of its side. The *horizontal lamina* may form, with its fellow, the occipital segment of the cranial floor, and, it may be, the hinder portion of roof the of the saccular cavity of its side. The *otic mass* of the bone lies in front of the buttress, between the diverging anterior ends of the superior and inferior vertical laminæ. For the most part this mass lies above the floor level, but may extend below it. The otic mass takes a greater or smaller part in the formation of the posterior ampullary fossa.

That part of the prootic which is presented on the ventro-lateral aspect of the cranium may be termed the *body* of the bone. From the inner side of this the *horizontal lamina* extends to the mid-line to meet its fellow of the opposite bone. The horizontal lamina forms the prootic segment of the cranial floor, the roof of the anterior part of the myodome, and the median sloping wall and floor of the saccular cavity in its fore part. Above the horizontal lamina the body of the bone is excavated on the inner side for the formation of the trigemino-facialis fossa, part of the arcuate recess, part of the anterior ampullary fossa, and the upper fore part of the cavum sacculi; the sloping medial floor of this cavum, on the horizontal lamina, dips below the level of the prootic cranial floor. The trigemino-facialis chamber is lodged on the outer side of the body near the anterior margin. Below and behind this chamber, the *myodomial wing* extends down and medially from the lower lateral margin of the body. This ala myodomialis is more or less covered below by the synpterygoid bone.

The basisphenoid presents a *horizontal lamina* forming the prepituitary segment of the cranial floor and the roof of the entrance to the myodome, and a *vertical process,* which sutures with the hinder end of the vomerine process of the synpterygoid.

The occipital crest of the supraoccipital bone needs no defining. The bone also develops horizontal and *vertical laminae* of varying extent; the horizontal lamina will be designated the *body.*

The epiotic process also needs no definition. The *body* of the bone shares with great constancy in the formation of the posterior ampullary fossa, and forms the greater part of the posterior semicircular bony canal, if, indeed, it does not form the whole of that canal.

The opisthotic bone may be a mere squame plastered over the meeting point of more or fewer of the other otic bones, or, pushing deeper into the otocranial wall, it may share in the bounding of the posterior semicircular canal, or again, the bone may be absent altogether, or it may be intimately fused with one or other of the remaining otic bones.

The pterotic is another well known process. The body of the bone very constantly shares in the formation of the two ampullary fossæ but especially the anterior one, and lodges the greater part of the horizontal semicircular canal.

The outer side of the body of the sphenotic bears the upper half of he anterior hyomandibular facet; the anterior surface of the body has frontal and alisphenoidal margins; the dorsal surface lies, in part, beneath the hinder end of the frontal bone. The internal aspect of the body is excavated to form the upper portion of the arcuate recess.

The body of the alisphenoid sutures with the frontal and sphenotic above and it gives of from its lower margin a *pterygoid process* which stands out and down to suture with the alisphenoid process of the synpterygoid and with the prootic just in front of the trigemino-facialis chamber.

The frontal bones develop a more or less extensive *sphenoidal process* which sutures towards its hinder extremity with the alisphenoid bone, and in front with the postero-superior processes of the prefrontal.

The synpterygoid develops paired ascending *alæ* and a median vertical *vomerine process,* and may develop paired *alisphenoid processes.*

Postfrontal bones are not of constant occurrence; when present they are little more than small squames of bone placed lateral to the frontals at the hinder edge of the roof of the orbit.

The body of the prefrontal bone may be defined as that portion which appears behind and, at times, below the nasal capsule. This bears anterior and posterior maxillary facets for the articulation of the maxilla. Posteriorly *superior* and *inferior processes* are given off to suture with the anterior end of the sphenoidal process of the frontal and the anterior end of the vomerine process of the synpterygoid bone respectively.

The mesethmoid presents no parts or processes that call for special designation.

The premaxilla presents a body, with ventral *alveolar margin,* and *palatine process.*

None of the bones of the palate and suspensorium except the maxilla

present processes which call for special designation. The anterior prolongation of the maxilla has been termed in the past the maxillary process. This will be designated the *labial process* in these contributions. This designation is necessitated by the nomenclature according to the new interpretation of the bones of the palate which is adopted here.

Swinnerton[11] proposed the terms panartete, disartete, and acrartete for the three types of attachment of the maxilla to the prefrontal. I have not met these terms elsewhere in literature but they are worthy of utilisation.

An extension of Swinnerton's nomenclature for the maxillary articulation is proposed in No. V. of these studies (p. 217).

In somewhat similar manner the hyomandibular may be slung to the cranium by one, two, or three short oval or circular joints, or it may be attached along the whole of its dorsal margin to one long articular furrow. It will be useful to be able to describe these modes of attachment by single words. Monarticulate, binarticulate, and trinarticulate are ready to our hand for the first three, and for the fourth condition *plenarticulate* is proposed.

Thus the suspensorium of *Epinephelus* will be described as trinarticulate, and the anterior attachment of the maxillary arch as disartete.

No. IV. Some Scleropareian Skulls.

Platycephalus.

(Figs. 1-4.)

INDEX OF ABBREVIATIONS USED ON THE DRAWINGS.

Al. alisphenoid.
An. angular.
Ar. articular.
B. oc. basioccipital.
B. sph. basisphenoid.
D. dentary.
Ep. ot. epiotic.
E. oc. exoccipital.
F. frontal.
Hym. hyomandibular.
I. op. interopercular.
I. sep. interorbital septum.
La. first suborbital.
Mes. eth. mesethmoid.
Mx. maxilla.
Mx. lab. maxillary labial.
Na. nasal.
Op. operculum.
Op. ot. opisthotic.
O. tr. os transversum.
P. and Pa. parietal.
Pal. palatine.
P. e. c. preethmoid cornu.
P. fr. prefrontal.
P. mx. premaxilla.
P. mx. lab premaxillary labial
P o. f. postfrontal.
P. op. preoperculum.
P. or. postorbital bones.
Pr. ot. prootic.
Pt. post-temporal.
Pter. pterotic.
Q. j. quadrato-jugal.
Qu. quadrate.
S. cl. supraclavicular.
S. o. suborbital bones.
S. oc. supraoccipital.
S. op. suboperculum.
Sph. sphenotic.
St. supratemporal.
Sy. and Sym. symplectic.
Syn. and Syn. pg. synpterygoid.

Platycephalus marmoratus Stead, has provided the material on which the following description is based. This species is commonly

[11]Swinnerton—Quart. Jour. Micro. Soc., xlv, 1902, pp. 503-593.

brought in as a table fish, so that I have had ample material to disarticulate.

The cranium presents a fairly flat dorsal surface, broad behind, narrower between the eyes, broad again where the prefrontals are placed and once more narrowed in the ethno-nasal region.

The otocranes are situated on the same transverse plane as the *cavum cranii*, not, as in some forms, below it, so that there is rather more lateral expansion in the hinder part of the skull than is usual in the skull of members of the sub-order. This expansion is further increased by the development of laminæ of bone for the attachment of muscles from the opisthotic outward to the outstanding posterior process of the pterotic bone.

On the under-surface of the skull the well developed saccular bullæ are prominent, recalling those of certain of the Siluroid fishes. In front of the bullæ there is on each side an out-turned process of the synpterygoid, which, though it does not reach the *os transversum*, calls to mind the " parasphenoid peg " described by Ridewood[12] in *Osteoglossum*, *Arapaima*, *Heterotis*, and *Pantodon*. It might appear from my drawing (fig. 4) that this process articulates with the palatine bone, but this is not so, the process is on a higher plane than the palate. As is usual among the members of the Acanthopterygii there is no " sphenoidal cavity."[13] The myodome is shallow.

THE CRANIUM.

Supraoccipital. The body of the supraoccipital bone (*S. oc.*) is more extensive than the area exposed, being overlapped by both the parietal and frontal bones. The vertical occipital crest is a fairly long lamina of bone which overhangs the foramen and the hinder limit of the basioccipital bone. There is a shallow muscle recess immediately beneath the arcuate hinder border of the body of the bone on either side of the crest. The floor of this recess is a thin horizontal lamina of bone attached on the one hand to the under side of the hinder border of the body, and on the other hand to the occipital crest about the middle of its depth. The lamina narrows as it proceeds back, and is in sutural connection with a similar but much smaller lamina attached to the inner side of the epiotic bone. For purposes of future reference these laminæ are now termed the " muscle laminæ " of the supraoccipital and epiotic.

On the under side of the body of the bone a stout vertical process projects down and backward from just in front of the attachment of the muscle lamina; the lateral edge of this process articulates with the epiotic and the inferior edge with the two exoccipitals. From the centre of the hinder face of this process the " occipital-crest " extends back to the foramen magnum, articulating with the two exoccipitals, taking, however, no part in the bounding of the foramen, for the two exoccipitals meet below it.

The suture between the vertical process and the two exoccipitals is situated just in front of the anterior limit of the medulla.

The *Parietal* (*Pa.*) is a squame of bone which overlies the body and

[12] Ridewood—Jour. Linn. Soc. (Zool.), xxix, 1905, pp. 252-282.
[13] Kesteven—Jour. R. Soc. N.S. Wales, lix, 1925, pp. 108-123.

the root of the posterior process of the epiotic bone, part of the side of the body of the supraoccipital, and a narrow area of the inner side of the pterotic; it is overlapped in front by the frontal, and, beneath this

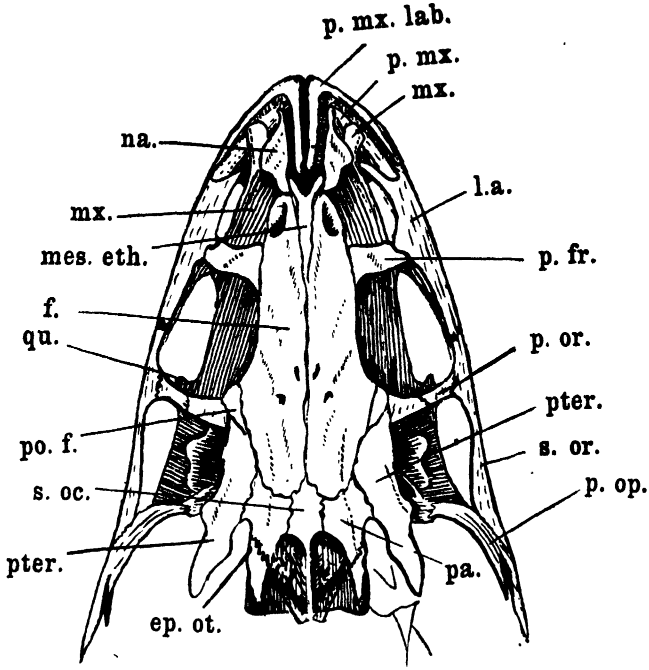

Fig. 1. *Platycephalus marmoratus* Stead.

bone, is in sutural contact with the prootic at the postero-median corner of that bone. The bone appears on the roof of the *cavum cranii* within, between the supraoccipital and the pterotic, in front of the epiotic and behind the frontal. The area so exposed on the inner side is small but quite definite.

The *Epiotic* bone (*Ep. ot.*) is wedged in between the parietal above, the supraoccipital to the inner side, the exoccipital and opisthotic below, and the pterotic laterally. The body of the bone is roughly pyramidal, hollow, and open in front. The cavity is divided by a sloping lamina of bone into an upper and lower compartment. The upper compartment lodges the upper part of the superior semicircular canal, the lower, is the upper half of the posterior ampullary fossa; both are, in the dried skull, freely open to the cranial cavity. The very short posterior bony semicircular canal lies behind the sloping lamina. The epiotic process projects well back over the outer edge of the exoccipital, and bears on its infero-median edge near the body the muscle lamina already referred to.

The *Pterotic* bone (*Pter.*) as viewed from above is very similar to the parietal and epiotic together. The body is a hollow mass of irregular

shape, which is sutured to the epiotic on the inner side, the opisthotic below and behind, the prootic below and in front, and on the dorsum of the skull with the sphenotic, frontal, and parietal bones. The cavity of the bone (anterior ampullary fossa), contains part of the anterior semicircular canal. The posterior semicircular canal passes through the back of the body from the depth of the ampullary fossa to reach the depth of the posterior ampullary fossa.

The elongated pterotic process bears a narrow muscle lamina, similar to those of the supraoccipital and epiotic bones, which, inclining in and downward, connects with a muscle lamina of the opisthotic.

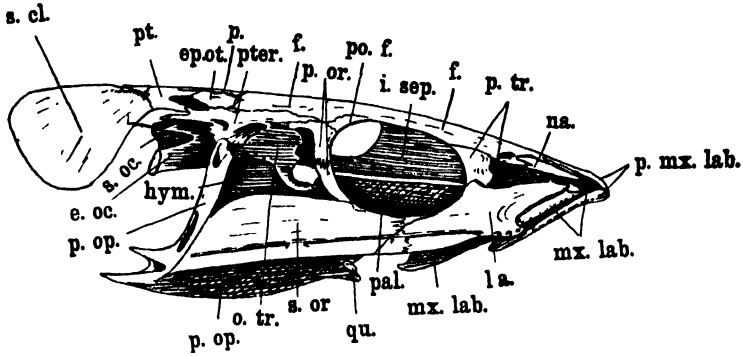

Fig. 2. *Platycephalus marmoratus* Stead.

The *Opisthotic* bone (*Op. ot.*) is of irregular shape, as exposed on the ventral aspect of the skull; it articulates with the exoccipital, prootic, and pterotic bones, posteriorly it is in sutural connection with the exoccipital and epiotic. At the apex of the temporal fossa, formed between this bone and the epiotic and pterotic, the opisthotic articulates with the inner side of the pterotic, and from this point the suture between the muscle laminæ af the two bones is continued back along the floor of the fossa. The suture between the opisthotic and epiotic, visible in the posterior view of the skull, is continued forward along the inner wall of this fossa.

The *Exoccipital* (*E. oc.*) is another bone of quite irregular shape. The solid neutral facet is the most outstanding portion of this bone as seen in a lateral or ventral view of the skull; the lower edge of the facet articulates with the basioccipital bone. Above the facet and its buttress the superior vertical lamina rises to meet its fellow of the opposite exoccipital and form the lateral boundary of the foramen magnum; this lamina is continued forward to form the whole of the postotic wall of the *cavum cranii* as far forward as the posterior limit of the otocrane and the anterior end of the medulla. At its anterior end the lamina in question turns outward and comes to look forward, here articulating with the inferior margin of the vertical process of the supraoccipital. Turning again to the base of the skull, the inferior vertical lamina of the bone will be seen extending between the pterotic and prootic bones, before reaching the prootic; this lamina is in sutural connection medially with the lateral lamina of the basioccipital. In front of the lamina

described as constituting the side wall of the brain box the otic mass of the bone enters into the formation of the otocrane. This portion of the bone is roughly pyramidal in shape and is hollow anteriorly; below and to the inner side of this the inner surface of the inferior vertical lamina just described on the base of the skull is found to contribute to the floor and side wall of the *cavum sacculi* posteriorly. The more massive portion of the bone forms portion of the posterior ampullary fossa; it articulates with the prootic, opisthotic, pterotic, and epiotic bones.

The temporal fossa has been described situated between processes of the epiotic, opisthotic, and pterotic bones. The occipital fossa is situated beneath the muscle laminæ of the supraoccipital and epiotic; its median wall is the occipital crest, the much less extensive floor is formed by laminæ from the exoccipital and opisthotic. The sloping anterior wall is contributed to by the posterior surface of the otic mass of the exoccipital, the epiotic, pterotic, and opisthotic bones; it is in fact the posterior wall of the otocrane.

The *Basioccipital* (*B. oc.*) sutures with the two exoccipitals and with the prootics. The condyle is of the usual vertebral centrum shape; the dorsal periphery of the condyle forms the floor of the foramen magnum.

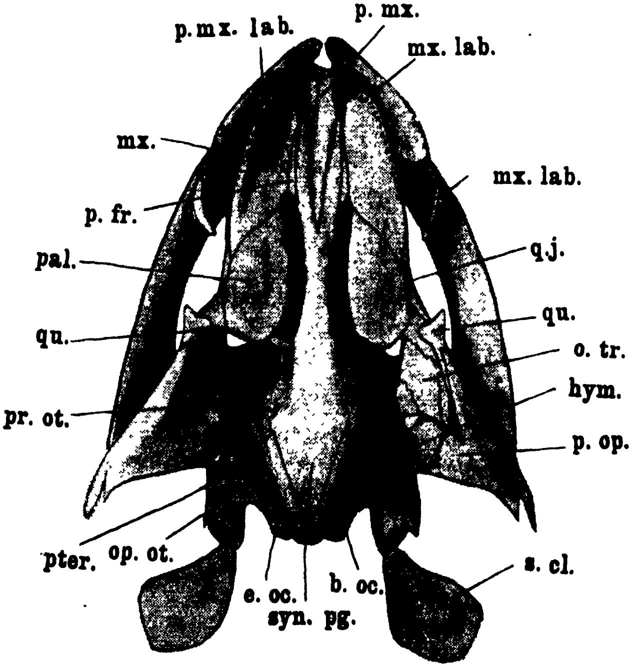

Fig 3. *Platycephalus marmoratus* Stead.

The bone is slightly constricted in front of the condyle and then expands laterally as it extends forward. The ventral surface is for the most part covered by the hinder end of the synpterygoid, the superior surface

is hollowed on either side of the mid-line by the two saccular recesses. The myodomial recess is very constricted and stops short at about the centre of the length of the bone. There are no horizontal laminæ in the exoccipitals, and the azygos sinus is a wide open, shallow, spoon-shaped fossa.

The *Sphenotic* (*Sph.*) is a triangular bone overlapped by the frontal and pterotic above, sutured to the alisphenoid in front, the prootic below, and meeting the pterotic again behind the last mentioned bone. The last three sutures are between the bones named and the edge of a descending process of the sphenotic. The outer aspect of the body bears the upper half of the anterior facet for the articulation of the hyomandibular bone. The upper part of the arcuate recess and portion of the anterior ampullary fossa are lodged in the substance of the body.

The prootic bones constitute the greater part of the saccular bullæ, which, as already noted, are particularly large in this species. The trigemino-facialis chamber is borne on the body of the bone near the anterior end, and the lower half of the anterior hyomandibular facet appears as though the outer wall of the chamber had been developed as its buttress. In front of the chamber the bone sutures with the alisphenoid below and the sphenotic above. Below and behind the chamber the body of the bone swells out to form the saccular bulla. Looking at the bone from in front, the horizontal lamina and the myodomial ala may be seen to spring together from the body just below the hyomandibular hemi-facet, their common line of attachment passing toward the midline and ventrally. From the line of attachment the two shelves extend medially, the former almost in the horizontal plane, the latter sloping down. The horizontal lamina sutures with its fellow, the myodomial ala beds into a recess on the upper surface of the synpterygoid. The postero-dorsal margin of the bone sutures with the inferior vertical lamina of the exoccipital, the epiotic, and pterotic bones. Viewed from within, the trigemino-facialis fossa is seen near the anterior margin of the body with the short margin of suture with the basisphenoid in front and to the inner side if it. The lower half of the arcuate recess lies above the nerve fossa, with the lower half of the anterior ampullary fossa just behind it. The portion of the horizontal lamina which forms the prootic cranial floor is triangular, the lateral side of the triangle being slightly arcuate, so that the fore part is broad and the hinder part tapers away to a point. From the arcuate border the horizontal lamina dips down to meet the body of the bone on the floor of the saccular cavity at the line of origin of the myodomial ala.

The *Alisphenoid* (*Al.*) is a small triangular bone placed between the prootic below and behind, the frontal above in front, and the sphenotic above and behind. The pterygoid process sutures with the horizontal lamina of the basisphenoid, and alisphenoidal process of the synpterygoid.

The *Frontal* bones (*L.F.*) are long and narrow; they suturate with the supraoccipital, parietal, pterotic, sphenotic, postfrontal, prefrontal, mesethmoid, nasal, and alisphenoid bones; all these sutures except the last are visible on the dorsum of the skull.

The *Postfrontal* (*Po.f.*) is a small squame of bone inserted between

the frontal and sphenotic at the postero-superior corner of the orbit, and giving attachment to the upper postorbital bone.

The *Basisphenoid* (*B. sph.*) is a quite small triradiate bone, the horizontal lamina articulating with the prootic and alisphenoid bones and the vertical process with the vomerine process of the synpterygoid.

There is a small foramen at the meeting point of the inferior vertical lamina of the exoccipital, prootic, and epiotic bones. Apparently the internal carotid artery enters through this and crosses the outer wall of the cavum sacculi to reach the hypophysis.

The *Synpterygoid* (*Syn. pg.*) is a long thin bone bearing some resemblance to a double-ended spatula. It lies in the midline beneath the basioccipital, the prootics, and the mesethmoid. The palatine plate of the premaxilla lies below it in a groove along the centre of its forward part. The broadest portion of the bone lies below the fore end of the prootics. The bone narrows rapidly in front of this widest part and then quite suddenly expands laterally, where an auriculur alisphenoidal process is developed below the basisphenoid and the myodome. It is the outstanding anterior corner of this process which calls to mind the "parasphenoid peg" described by Ridewood in certain forms already referred to. A vertical "vomerine" lamina is present along the centre of its dorsal surface, forward of the basisphenoid.

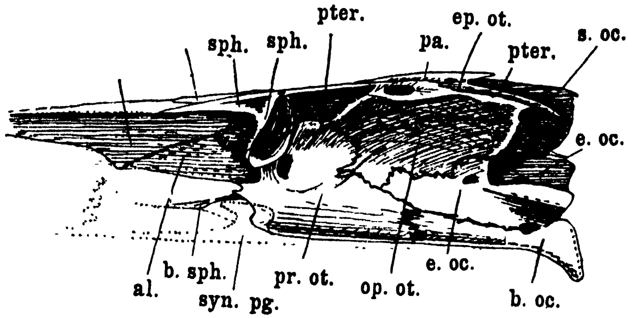

Fig. 4. *Platycephalus marmoratus* Stead, side view of the cerebral region of the cranium.

The *Prefrontal* bone (*P. fr.*) presents a roughly quadrilateral area on the dorsal surface of the skull; there is also a small triangular area in front of this at a deeper level on the inner side of the nasal fossa at its hinder end. The outer edge of the fore end of the frontal bone lies above a narrow area of the prefrontal and covers a narrow posterior dorsal process of the latter. When the prefrontal bone is disarticulated it is found that the dorsum of the bone has a triangular outline, but with the out-turned apex truncated; at this apex there is a saddle-shaped facet, for the articulation of the first subocular bone. The fore end of the median dorsal margin of the prefrontal sutures with the body of the mesethmoid. The ventral surface of the bone is very similar in outline to the dorsal, but smaller; the median edge is sutured to the synpterygoid. The ventral and dorsal surfaces are inclined at an angle to one another, the angle open posteriorly, so that a fairly considerable

recess is present between the upper and lower portions of the bone; at the depth of this recess the bone is perforated for the passage of the terminal branch of the superficial ophthalmic division of the trigeminal nerve and the olfactory peduncle, the former having its internal opening further back than the latter and more toward the side.

The *Mesethmoid* bone (*Mes. eth.*) is almost completely incased in other bones. The body of the bone lies in front of the frontal bones; portion of the dorsum is here exposed on the back of the skull, and a narrow posterior process extends back between the fore ends of the frontal bones, and this also is exposed on the back of the skull. From the front of the body two spurs stand forward and slightly upward; they embrace the tips of the ascending processes of the premaxillary labial bones and give attachment to the base of the nasals on their outer side. Below the spurs the bone is continued forward and down by two narrow squames which suture with the dorsal processes of the premaxilla.

The upper and lower moieties of the frontal bones thicken as they pass forward, so that there is quite an extensive interval between the point of union of the inner and outer surfaces on the median aspect of the bone; there is thus formed on this aspect of the bone a roughened area. When the prefrontals, synpterygoid, and mesethmoid are placed in correct position it is found that the rough areas on the prefrontals are continuous with a similar area on the back of the mesethmoid, and in this region the four bones surround a cavity, which, in the fresh state, is filled by the cartilaginous ethmoid to be described later.

The *Nasals* (*Na.*) are small triangular leaflets of bone attached to the outer side of the mesethmoid spurs, to the ascending processes of the premaxillary labials, and the labial process of the maxilla by fibrous tissue.

The *Premaxilla* (*P. mx.*) presents a short solid body and a long narrow palatine lamina as seen from below. The palatine lamina is strongly concave upwards and, at its union with the body, there rises on each side a short dorsal process; as already stated this latter sutures with the mesethmoid.

The mass of cartilage which is provisionally termed the *cartilaginous ethmoid* is T-shaped in cross section. Posteriorly, where it forms the interorbital septum, it is thin, and appears to be planted inferiorly on the upper edge of the vertical lamina of the synpterygoid; forward of the orbit it becomes much thicker, and is clearly seated on the upper surface of the anterior lamina of the same bone, and is incised along the centre to receive the dorsal lamina. The horizontal portion of the cartilage, like the vertical, is much thinner posteriorly than in front. The mass is very nearly divided into a smaller anterior and much larger posterior portion beneath the mesethmoid, where that bone bulges down nearly to the dorsal surface of the palatine plate of the premaxilla. In front of this point the cartilage is dorso-ventrally compressed, and fits in between the palatine plate and the dorsal processes of the palatine bone; a small gap between the bones here exposes the cartilage below the fore end of the mesethmoid bone.

CIRCUMORBITAL BONES.

(Figs. 1 & 2 s. or., p. or., la.).

There are two suborbital bones and two postorbitals; of these the anterior suborbital is an elongate triangular bone with the short anterior side deeply sinuated, so that the most anterior point lies behind and parallel to the shaft of the maxillary labial, whilst the lower point overlies both labial bones. At the junction of the anterior and middle thirds of the length of the dorsal edge the bone is thickened and developed into an articular condyle for the formation of a true joint with the lower edge of the prefrontal bone. The posterior suborbital is roughly quadrilateral, with a very acute angle between dorsal and anterior edges, and a consequential obtuse angle between anterior and ventral surfaces. The ventro-posterior angle is also acute, whilst the postero-dorsal angle is slightly obtuse and rounded off. The two postorbitals are small narrow bones, the dorsal attached to the postfrontal and the ventral to the posterior suborbital. These last two bones form the posterior boundary of the orbit and carry a branch of the latero-sensory canal system.

PALATE AND UPPER JAW.

The general shape of the palate and its constitution are shown in the drawings is sufficient detail to permit of very brief description.

The *Maxilla* is a fairly substantial bone, which may be described as having palatal, dorsal, and facial surfaces. The palatal surface is roughly triangular in outline, and hollowed longitudinally. Teeth are born only along the outer edge separating facial from palatal surfaces. The facial surface is broader in front than behind, and may be said to be the outer surface of the lateral wall of the trough on the palatal surface. When the mouth is fully open and the labial bones pulled well down there is formed a trough between the inner face of the suborbital bones and the facial surface of the maxilla. Both walls of this trough are lined by the skin, this and a thin layer of subdermal tissue alone covering the bony walls of the trough. At the alveolar margin of the maxilla the palatal epidermis, buccal mucosa, is reflected on to the inner side of the skin of the facial surface of the bone, and the two together are continued downward, presently to be separated again to enclose first the maxillary then the premaxillary labial bone. This double membrane including the labial bones is, of course, the true lip. The facial surface of the maxilla passes insensibly into the dorsal surface, though in a freshly prepared bone the true subdermal surface is clearly defined by its smoother finish. A ridge just to the median side of the upper limit of the facial surface marks the centre of a long narrow area along which a band of very tough fibrous tissue is attached. This band gathers to its greatest thickness immediately beneath the prefrontal bone at a point marked by the development of a small tubercle; this last is an imperfect facet for articulation with the prefrontal. Fibrous and fibro-cartilaginous tissue is also attached to the whole of the dorsal surface of

the bone to the inner side of the ridge just described. All of the fibres of this dense tissue are attached above to the under side of the prefrontal bone. The labial process (maxillary process) rises from the anterior end of the dorsal surface of the bone and stands forward a little distance; at its root, on the inner side thereof, there is a small spur developed, which looks toward, and is attached to the premaxilla by very tough fibro-cartilage. The upper surface of the spur articulates with the pre-ethmoid cornu of the cartilaginous ethmoid.

The *Palatine* is a thin squame of bone of the shape indicated in the drawing.

The *Quadrato-jugal*[14] is a small splint of bone sutured to the outer edge of the palate, where it is in contact with the maxilla, palatine, and quadrate; its extreme anterior tip lies inside the extreme posterior tip of the maxilla.

The *Os Transversum* is of irregular shape, fitted in between the palatine and quadrato-jugal in front, quadrate and symplectic to the outer side and the hyomandibular to the inner side and behind.

The *Quadrate* presents a stout shaft, lying along, and firmly attached to the inner side of the antero-inferior arm of the preoperculum. This shaft bears the articular facet on its anterior free end; the facet is as usual elongated in the horizontal and transverse plane, the inner end being, again as is usual, deeper from above down than the outer end. To the inner side of the shaft the quadrate presents an expanded palatal amina; this is broadest anteriorly, and sutures with the quadrato-jugal palatine, and os transversum.

The *Symplectic* is of the typical narrow elongated shape; proximally it is sutured to the hyomandibular and preoperculum by hyaline cartilage, and the greater part of the median border is attached in the same way to the os transversum. Distally one third of the bone is imbedded in hyaline cartilage in a depression on the inner face of the quadrate immediately to the inner side of the shaft.

The binarticulate *Hyomandibular* is an irregularly shaped flat bone; it may be said to present a nearly straight median border, which makes the base of an irregularly indented semicircle. The middle third of the base line is occupied by a low boss, the posterior articular facet. Immediately in front of the base the curved outer border begins with the well developed anterior articular facet; beyond this the edge is slightly excavated, and there follows a double facetted area; the symplectic articulates with the anterior of these two, and the preoperculum and inter-hyal articulate with the other, the inter-hyal on the inner side, the hyomandibular on the outer. Behind this double facet the edge is again excavated, and the posterior segment of the border is occupied by the facet for the articulation of the operculum.

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[14] It is now realised that this identification of the bone is incorrect; its position medial to the muscles of mastication is alone a sufficient proof that the bone cannot be the quadrato-jugal. On the other hand it is with equal certainty not the pterygoid. To attempt an enquiry into its correct identification here would be out of place, and in these papers the term quadrato-jugal will be used until opportunity offers to undertake that enquiry.

This description is taken from the hyomandibular of *P. fuscus* Cuvier and Valenciennes.

LATERO-SENSORY CANALS.

It has not been possible to work out this system in detail; there is one canal down each side of the dorsal surface of the skull, with temporal and supraoccipital cross bars. The temporal chain is continued down along the postorbital bones to join the suborbital chain, whilst the supraoccipital chain is continued down along the posterior margin of the preoperculum to the lower jaw.

MYODOME.

In both *Platycephalus marmoratus* and *P. fuscus* the myodome is very much dorsoventrally compressed, and it extends back only to the middle of the length of the basioccipital bone in *P. marmoratus*, and to the posterior end of the prootic in *P. fuscus*. The pterygoid process of the alisphenoid is produced further forward in contact with the alisphenoid process of the synpterygoid, so that the anterior end of the myodome is carried further forward than is usual.

Platycephalus fuscus Cuv. & Val. has also been examined, but the resemblance is such that this species may be very briefly dealt with. The palatine bone articulates with the os transversum. The description given above of the hyomandibular is founded on that of *P. fuscus*; that of *P. marmoratus* differs in having a thin squame of bone springing from the edge between the anterior articular facet and the double facet, and extending across to articulate with the os transversum, and in having the double facet standing out to a greater extent. In the cranium there is little that calls for comment, beyond the fact that the saccular cavities are adpressed to the sides of the skull so that saccular bullæ are not present.

NEOSEBASTES THETIDIS.

(Fig. 5.)

Of this species I have a single complete skull; in the drawing the attempt has been made to show the form of the component bones of the maxillo-palatine arch through the subocular scutes.

This skull presents features of resemblance to both the preceding and succeeding forms; the general shape is that of *Pterygotrigla*, whilst in the conspicuous sensory canals and the form of the cheek armature the resemblance is to *Platycephalus*.

The supraoccipital appears on the surface of the dorsum of the skull between the parietals; for the rest, excepting the prefrontal, the arrangement of the bones of the cranium and otocrania is so essentially the same as that of *Pterygotrigla* as to call for no separate description. There is no postfrontal, and the position of the prefrontals resembles that in *Pterygotrigla* rather than of the other genus, although they do not meet in the mid line on the dorsum of the skull; they are closely juxtaposed below in front of the orbit. The relation of the narrow nasals to the mesethmoid and prefrontal bones differs from both the other orms; they are planted in small recesses on the dorsum of the prefrontals

immediately in front of the fore end of the frontal bones, and project forward over the mesethmoid. The circumorbital bones are heavier but otherwise similar to those of *Platycephalus.*

The body of the *Prefrontal* is antero-posteriorly flattened and stands nearly vertically in the transverse plane, inclining, however, slightly backward above. Dorsally the body ends as a pointed squame underlying the antero-lateral corner of the frontal, but also showing on the dorsum of the skull, where it forms the anterior boundary of the orbit. No postero-dorsal process is developed. Though generally presenting the flattened appearance described, inferiorly the bone is triangular

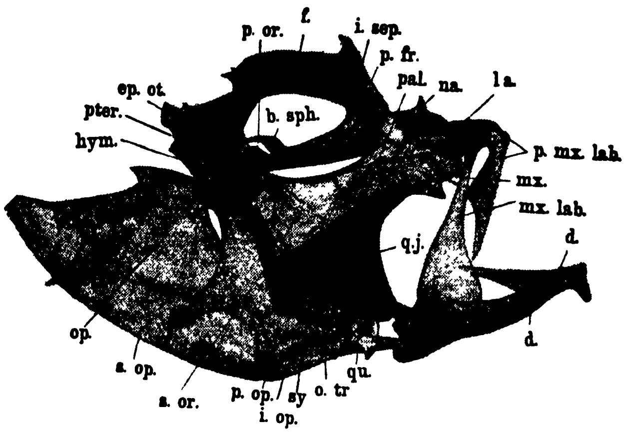

Fig. 5. *Neoscbastes thetidis* Waite.

when viewed either from below or from the median aspect. The outstanding infero-lateral angle bears a well developed facet; to the inner side of this the inferior free margin of the flattened portion of the bone is continued inward under the solid triangular portion, and terminates in a second, much smaller facet. The outer articular facet is for the first subocular bone, the inner for the posterior, parethmoid articulation of the maxilla. In front of the subocular facet the body of the bone is hollowed out, and there then stands forward a buttress which terminates as the facet for the pre-ethmoid maxillary articulation. The common foramen for the transmission of the olfactory nerve and the terminal branch of the ramus opthalmicus superficialis lies to the inner side of the root of this buttress, perforating the solid portion of the body. The ventral surface of the body is in contact with the upper surface of the synpterygoid. There is no infero-posterior process, and therefore no suture with the vomerine process of the synpterygoid.

The *Hyomandibular* bone is binarticular. The *Maxilla* is disartete, whilst the form of the bone is similar to that of *Platycephalus*, but the manner of its articulation is not the same. In this form both articulations are with the prefrontal, whilst in that the anterior is with the pre-ethmoid cornu of the ethnoid cartilage.

PTERYGOTRIGLA.

(Figs. 6-9.)

The following description is based on the skull of *P. polyommata* Rich., of which I have had for study four crania, two specimens in the flesh and a nearly complete skull dredged off Montague Island and forwarded to me by the Director, Australian Museum.

CRANIUM.

The general shape of the cranium is well shown in the drawings and hardly calls for description.

The *Supraoccipital* bone appears only on the posterior aspect of the

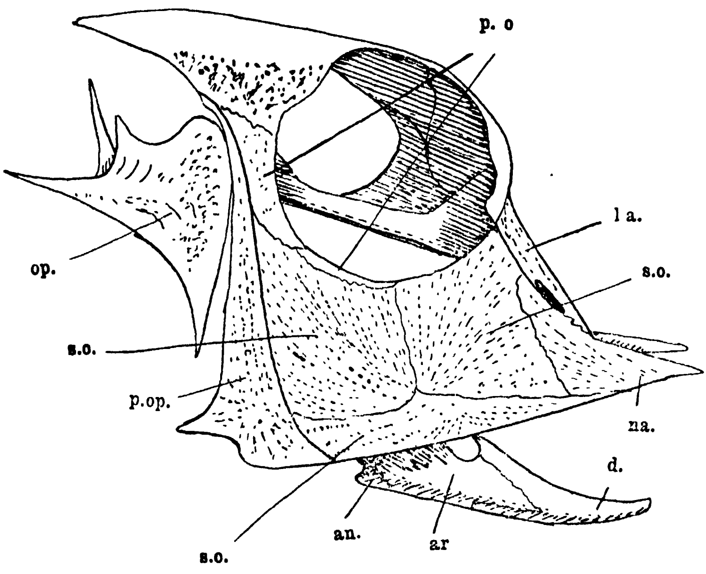

Fig. 6. *Pterygotrigla polyommata* Richardson.

skull; the body, similar in shape to that of *Platycephalus*, is completely hidden dorsally by the parietals and frontals, which meet in the midline above it. The vertical process is broad and arranged nearly in the transverse plane. The upper lateral portion of the vertical process enters into the formation of the postero-superior wall of the cavity for the posterior semicircular canal. The bone sutures with the parietals and frontals above, and the with epiotic and exoccipital of each side behind.

The *Epiotic* is a hollow pyramidal bone divided by a horizontal shelf into upper and lower compartments similar to those of *Platycephalus*. The bone sutures with the supraoccipital, parietal, opisthotic, and exoccipital bones.

The *Pterotic* appears to be represented by a small nodule of bone, wedged on the surface of the skull between the base of the supratemporal behind, the opisthotic in front, and the parietal to the inner side (*Pter.*).

The *Opisthotic* bone (*Op. ot.*) is placed higher in this form than in *Platycephalus* and occupies much the position of the opisthotic and pterotic together in that form, that is, relative to the intracranial structures. The sutural relations of the opisthotic are with the exoccipital, epiotic, pterotic, parietal, frontal, sphenotic, and prootic.

The *Exoccipital* bone (*E. oc.*) presents fairly expansive surfaces on both the posterior and lateral walls of the cranium, bounds the foramen magnum laterally, meets its fellow of the opposite side above, is excavated inside to form part of the posterior ampullary fossa and is in sutural connection with the supraoccipital, epiotic, supratemporal, opisthotic, prootic, and basioccipital bones.

The *Basioccipital* (*B. oc.*) is relatively a much smaller bone than in *Platycephalus*, the " saccula " recesses are very small but quite recognisable, and the body of the bone is excavated to form the hinder end of the myodome. The basioccipital sutures with synpterygoid, prootic, and exoccipital bones.

The *Sphenotic* (*Sph.*) may have the postfrontal fused with it, for that bone is otherwise not present. The sphenotic sutures with the opisthotic, frontal, alisphenoid, and prootic bones.

The *Alisphenoid* is quite a small squame of bone, which sutures with the sphenotic, frontal, and prootic bones. The suture with the frontal is immediately behind the alisphenoid lamina thereof, and the bone is here very much thickened to form a strong antero-superior wall to the cranial cavity. The frontal bones are excluded from actual participation in the formation of the ceiling of the cavity by the epiphysial cartilage, which underlies them between the alisphenoid, superior periotic bones, and the supraoccipital. There is no pterygoid process.

The *Prootic* (*Pr. ot.*) bone is, as usual, bilaminate inferiorly, the upper horizontal lamina forming the floor of the cranial cavity, the lower myodomial process the outer part of the floor of the myodome. Above the junction of these two laminæ the body of the bone provides an extensive area of the side and front wall of the cranial cavity. The bone sutures with the exoccipital, synpterygoid, basisphenoid, alisphenoid, sphenotic, and opisthotic bones. The outer wall of the trigemino-facialis chamber is a mere spicule of bone.

The *Basisphenoid* bone is of the typical triradiate form; the horizontal lamina sutures with the prootics, and the somewhat longer vertical process with the vertical lamina of the synpterygoid.

The *Parietal* bones (*Pa.*) are thick, flat, cancellous bones, whose shape is well shown in the drawing.

The shape and situation of the *Frontal* bones is sufficiently indicated in the drawings. (*F.*). There is a small alisphenoidal lamina developed on the under side in front of the alisphenoid bone and also to the medial side thereof, the latter portion forming the extreme antero-median and upper part of the front wall of the cranial cavity.

The *Synpterygoid* (*Syn. pt.*) is essentially similar to that of *Platycephalus*. There is however no auricular alisphenoidal process; this is

probably correlated with the much larger eye-muscle canal in the present form.

The *Prefrontal* (*P. fr.*) bones are remarkably massive and meet in the midline and occupy the space which in *Platycephalus* is occupied by the cartilaginous ethmoid. Like the prefrontals of that form these are perforated for the passage of the olfactory peduncle and a terminal branch of the superior ophthalmic division of the fifth nerve.

The *Mesethmoid* (*Mes. eth.*) is presented on the dorsum of the skull between the prefrontal and nasal bones; a posterior spur extends back between the two prefrontals but is hidden beneath them. The body of the bone is massive and extends down almost to the synpterygoid, leaving only a very shallow space between to be filled by cartilage.

The shape of the *Nasal* squames is indicated in the drawing.

The *Premaxilla* (*P. mx.*) is essentially similar to that of *Platycephalus*, a little broader in front and having rather more of the dorsum exposed in front of the mesethmoid, but with the same processes and containing the anterior smaller part of the cartilaginous ethmoid between the dorsal processes and the palatine lamina.

CIRCUMORBITAL BONES.

There are four suborbital bones and two postorbitals; of these latter, one is actually suborbital in position, but there is little doubt that it is truly a postorbital. The anterior suborbital is firmly attached to the labial process of the maxilla and to the nasal bone. The attachment to the nasal is double, the anterior point to the anterior process of the bone and the posterior to the body of the bone; between the two points of attachment there is a gap between the bones, and in the flesh the two apertures of the nasal capsule are found in this gap. Two of the suborbital bones are attached to the preoperculum, as also is the upper postorbital. Except for a small area surrounding the eye, the whole of the face is encased in the circumorbital bones. These as well as the dorsal covering bones are all subdermal and finely shagreened in radiating patterns. The area between the two anterior suborbitals alone is unprovided with a subdermal bone.

PALATE AND UPPER JAW.

These bones are arranged almost in the vertical plane, and there is little that calls for special mention either in their shape or their relations. The maxilla is articulated to the pre-ethmoid cornu at the margin of the premaxilla, and attached to the front outer corner of the prefrontal and to the two anterior suborbital bones. The hyomandibular bone is binarticulate.

CRANIAL WALLS AND NERVE FORAMINA.

The lateral walls of the cranial cavity, and medial walls of the otocrania, are almost entirely membranous, so that there is practically no part of the preotic or postotic wall in the sagittal plane. The two lateral obturator membranes are almost in contact at the posterior end

of the roof; from this point each passes down and outward across the vertical lamina of the supraoccipital and the vertical lamina of the exoccipital just to the inner side of the posterior ampullary fossa. Below this each passes forward to the outer side of the foramen for the ninth

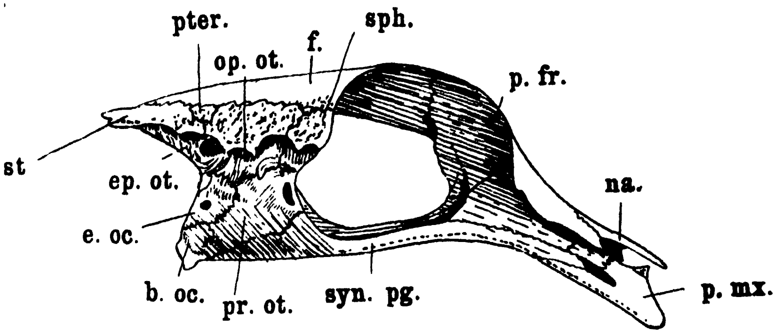

Fig. 7.

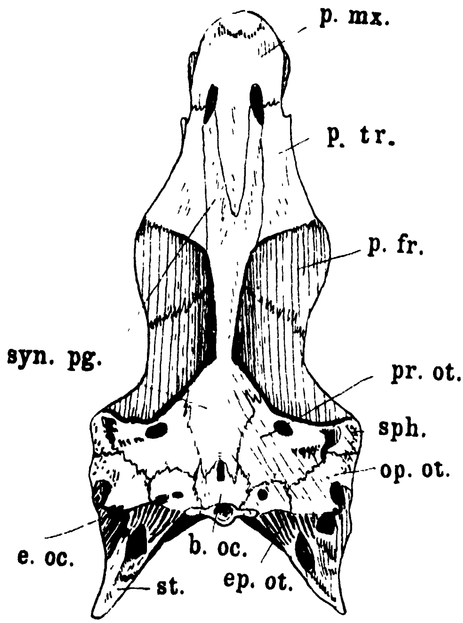

Fig. 8.

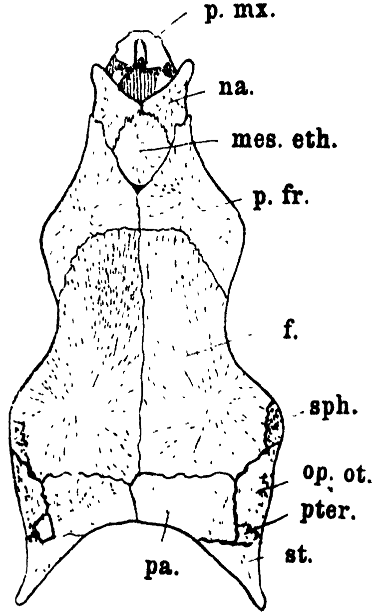

Fig. 9.

Figs. 7, 8, and 9. Three views of the cranium of *Pterygotrigla polyommata* Richardson.

and tenth nerves and on to the basioccipital. It crosses this bone along the edge of the inner margin of the saccular recess, then passes forward, along the floor of the cavity, first on the basioccipital and then on the horizontal lamina of the prootic. The anterior end of the cavum sacculi is indicated on the inner surface of the prootic by a small pit; im-

mediately in front of this the two foramina for the exit of the trigemino-facial roots are placed, at a slightly higher level. The membranous side wall swings to the outer side of these and then upward across the front wall, approximately along the line of suture between the alisphenoid and sphenotic, to reach the roof, which it crosses back to the starting point. The trigemino-facialis fossa is not defined, and the temporal fossa is very much reduced.

The floor of the cranial cavity as defined by the attachments of the membranous side walls is composed of the basioccipital behind and the two prootics in front with no basicranial obturator membrane between. There follows next the pituitary fossa, with its floor of tough membrane, and then the bar formed by the horizontal lamina of the basisphenoid, marking the lower limit of the front wall. Above the basisphenoid the front wall is composed of tough fibro-cartilage. The centre of this fibro-cartilaginous wall is attached to the septum interorbitale and lifts toward the dorsum cranii with a curve, the sides rising more rapidly, so that there is here formed a trough-like v-shaped forward prolongation of the cranial cavity immediately under the roof and above the hinder end of the septum. At the anterior termination of this cavity the olfactory nerves pierce its walls and pass forward on either side of the septum just under the frontal bones. The bony front walls of the cavity rise with a forward slope in the one plane to the roof. A wide shallow fossa on the occipital segment of the floor may represent the azygos sinus.

The optic nerves leave the cavity through the membrana spheno-obturatoria just above the basisphenoid.

Nerve iii penetrates the prootic bone just to the outer side of the basisphenoid, with the fourth nerve perforating the same bone immediately to its outer side.

The sixth nerve penetrates the prootic on the floor of the cavity just behind the pituitary fossa, and passes along under the roof of the myodome on its way forward.

The roots of the fifth and seventh nerves, intricately commingled, leave the cavity through two foramina in the prootic, lateral to and below those for the third and fourth nerves. The trigemino-facialis ganglion is apparently lodged in a shallow fossa on the front of the prootic bone; the outer wall of this fossa is perforated for the passage of the inferior trunks of the complex.

MYODOME.

This chamber is widely open in front, nearly as deep as it is wide, the floor extending forward so far as to be nearly as far in front of the anterior limit of the roof as the full depth of the cavity beneath the roof. The roof is composed of basisphenoid, prootic, and basioccipital bones; the floor, of prootic and synpterygoid. At its depth the chamber opens on to the base of the basioccipital bone.

SYNANCEJA.

This study of the skull of *Synanceja horrida* Linné is based on a single specimen which reached me in the flesh from the Trustees of the

Australian Museum. It was therefore not possible to check all the identifications of the nerve foramina ; they are, in consequence, to some extent determined by their position.

This skull is in many respects very dissimilar to any other scleropareian skull that has heretofore been described. I have therefore sacrificed the specimen to the description and have divided it down the mid sagittal plane and have disarticulated one half, so that, though based on a single skull, full reliance is placed in the accuracy of the description of the relation of the bones to one another.

In the flesh this head is indeed a bizarre specimen. The large suborbital hollows give it an appearance of extreme emaciation, the eyes are so small that in the formalin specimen they need looking for, whilst the large frontal eminences and supratemporal ridges impart the fearsome character that was doubtless responsible for its specific name.

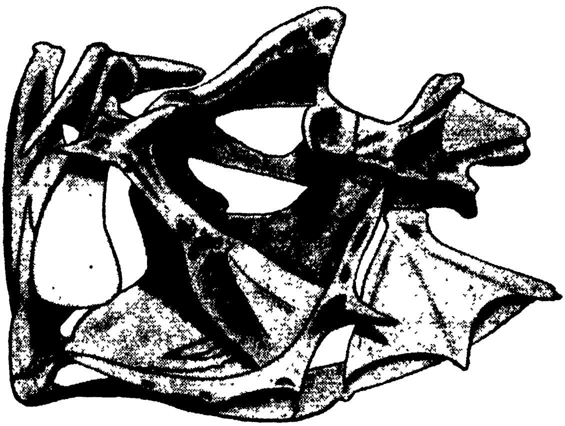

Fig. 10. *Synanceja horrida* Linné.

The cerebral region of the skull has a quadrilateral outline, with back and front sides sloping forward. From above the outline is roughly square, with an abruptly truncated wedge attached at the back. The dorsum of the skull is carried out in this region by relatively broad flanges developed from the sphenotic and pterotic bones ; between these there is a stepped-up, flat, central area. The hinder end of this flat area is flanked on either side by a large, dorsally projecting, flattened process developed from the parietal and epiotic bones. The epiotic component of this process is the epiotic process ; its base of attachment is in the usual position, but its abnormal dorsal extension disguises that fact. Behind these processes the dorsum of the skull falls away both laterally and posteriorly. The forward boundary of the cerebral region coincides with base of origin of the remarkable frontal eminences and an upturning of the postorbital process of the sphenotic. The occipital and temporal fossæ are but poorly separated from each other by a low ridge, which passes down and back from the middle of the broad attachment of the pterotic process. The dilatator fossa is a mere groove on the under surface of the postorbital process of the sphenotic bone, above the an-

terior hyomandibular facet. The temporal fossa does not extend upward between the epiotic and pterotic processes as is usual; low flanges from each of the two bones unite the processes and form the upper limit of the fossa. The hyomandibular is binarticulate. The posterior fossa is lodged on the side of the pterotic process as usual, and the larger anterior fossa is for the most part accommodated under the posterior edge of the postorbital process of the sphenotic, the prootic forming only the lower edge. The outer wall of the trigemino-facialis chamber is quite extensive, and is continued up to form a buttress to the antero-ventral corner of the sphenotic bone. The saccular bullæ, though not large, are quite obvious; they give rise to a low keel which starts below the trigemino-facial chamber and passes diagonally backward across the base of the skull to the mid line. The saccular cavities are separated only by a membranous partition beneath the cerebral floor, and, as the myodome is short, extending hardly behind the pituitary region; the basicranial axis is nearly parallel with the ventral line of the skull.

The orbital region of the skull is strikingly ornamented by the eminences of the frontal bones. The form of these extraordinary bosses can better be realised from the drawings than from description. Immediately under the bosses there is a broad, shallow, open furrow; in this the diminutive eyes are lodged. In front of the groove and boss each frontal is tilted in towards the midline, the two together forming a broad deep gutter down the forward part of the orbital region. The usual prefrontal mass is replaced by quite a small peg, standing out from a prefrontal bone which is much less massive than in other sclero-pareian skulls.

The preorbital region is broader and flatter than usual.

CRANIUM.

The *Basioccipital* presents the usual two saccular recesses above separated by a low central ridge. Below the fore part of the saccular recesses and the central ridge there is a low cavity which extends across the full width of the bone. The floor of this cavity is the upper surface of the basal lamina. Apparently the homologue of the posterior portion of the myodome of other forms, it does not communicate with the myodome in this, but is completely shut off from it by the suturation of the prootic with the basal lamina. The basal lamina is fairly broad, and forms, by its outer edge, the posterior end of the keel of the saccular bulla; the vertical lamina is low. In front of the condyle the dorsum of the bone forms part of the cerebral floor, but the major portion of this surface is occupied by a broad, shallow, spoon-shaped fossa, which is apparently the azygos sinus.

The *Exoccipital* is a very typical bone. The horizontal lamina curves round the side of the azygos sinus to meet its fellow of the other side in front of the dorsum of the basioccipital, there forming the anterior part of the occipital segment of the cranial floor and the hinder part of the roof of the saccular cavities. The buttress is but poorly developed, and the neural facet is intimately fused to that of the first neural spine, whilst the spine itself is as intimately fused to the hinder border of the superior vertical lamina. The vertical lamina is oriented in the longi-

tudinal plane of the body and arches over the foramen magnum to suture with the much reduced crest of the supraoccipital bone. The spino-accessory foramen is placed far back, its hinder margin being provided by the first neural spine. The otic mass of the bone accommodates the

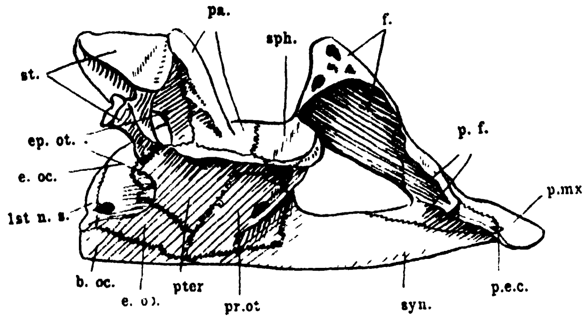

Fig. 11

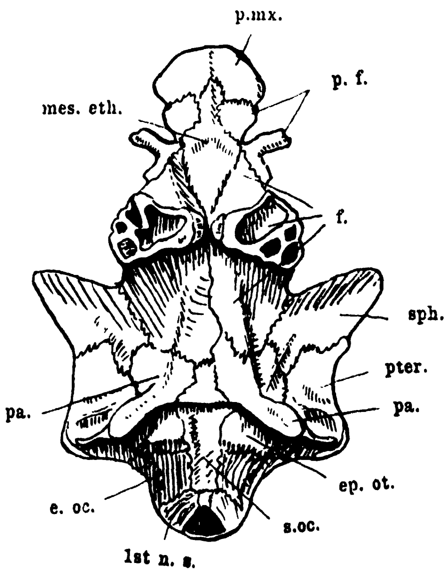

Fig. 12.

Figs. 11 and 12.—Cranium of *Synanceja horrida* Linné.

greater part of the posterior ampullary cavity and part of the posterior bony semicircular canal. The inferior vertical lamina is, relatively, a little more extensive than is usual.

The body of the *Prootic* bone forms the anterior portion of the saccular bulla and an area of the side wall of the skull in front thereof. The trigemino-facial chamber is situated on the upper part of the body and its outer wall is continued upwards to form a buttress to the lower

corner of the postorbital process of the sphenotic bone. The horizontal lamina is inclined at an angle of forty-five degrees to the central plane of the skull; the portion which forms the prootic segment of the cranial floor is quadrilateral in outline, the antero-medial and postero-lateral angles are very obtuse, and the other two angles correspondingly acute. The portion of the lamina which forms the anterior part of the floor of the saccular cavity is clearly defined by a slight ridge, and dips ventrally from that ridge. The body lodges the lower end of the arcuate fossa, a ridge of cartilage which is seated near the posterior margin of the body forming the anterior boundary of the anterior ampullary fossa.

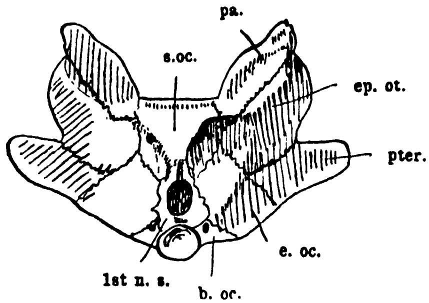

Fig. 14.

Figs. 13 and 14.—Cranium of *Synanceja horrida* Linné

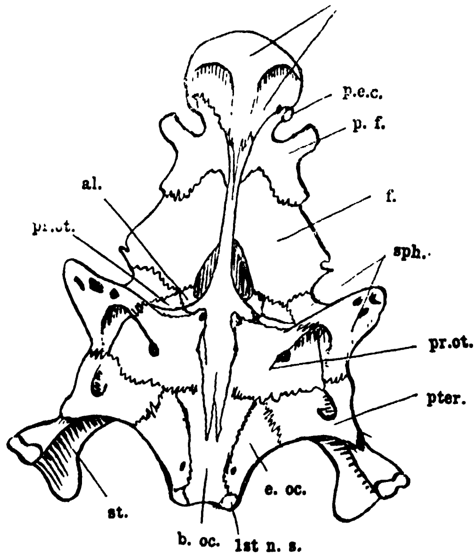

Fig. 13.

No *Basisphenoid* bone was found, nor is there any trace of fractured surface in the accustomed place where a basisphenoid bone sutures. It is concluded that no basisphenoid bone is present in the complete skull.

The *Supraoccipital* bone is smaller than is usual. There is but a small horizontal lamina and a much reduced crest, the latter lying flush with the dorsal surface of the skull, separating the superior vertical laminæ of the exoccipital bones.

The *Pterotic* lodges the anterior ampullary fossa and the short horizontal bony semicircular canal.

The body of the *Pterotic* is excavated to form a deep conical recess in the postero-dorsal corner of the otocrane, and the upper part of the posterior semicircular canal lies behind the back wall of this pit. The posterior hyomandibular facet is situated under the pterotic process.

No separate *Opisthotic* bone is present.

The *Sphenotic* provides a small area of the lateral wall of the cranial wall in the extreme antero-dorsal corner. The major portion of the anterior facet for the hyomandibular is borne on this bone just behind.

The *Alisphenoid* bone is represented by little more than the pterygoid process of other forms.

The *Frontal* bones have already been sufficiently described in the description of the orbital region of the skull.

Postfrontal bones are absent.

The *Mesethmoid* bone is diamond-shaped as viewed from above, the long axis of the diamond being in the length of the skull. The longer posterior half is concave whilst the anterior half is convex. The bone is overlapped by the fore ends of the frontal bones, and the posterior margin under those bones is nearly as broad as any part of the bone. The mesethmoid ridge is confined to the fore end of the bone.

The *Prefrontal* bone is almost devoid of the lateral preorbital lamina usually developed on this bone. An outstanding spur is developed for the articulation of the first suborbital bone. In front of this a marked sinus in the lateral margin is succeeded by a small facet with which the maxilla articulates. Immediately in front of this the pre-ethmoid cornu of the cartilaginous ethmoid is presented through a gap between this bone and the premaxilla.

The dorsal surface of the *Premaxilla* is flush with the surfaces of the prefrontal and mesethmoid ridge behind it. The alveolar margin is quite smooth and devoid of teeth, and is followed by an extensive palatal process, which is tapered off gradually to a point below the anterior end of the synpterygoid.

The *Synpterygoid* presents the usual features posteriorly. In the orbital region it is deep from above down, compressed from side to side, and grooved above. The groove widens slightly anteriorly and deepens markedly; the side walls of the groove suture with the postero-medial corner of the body of the prefrontal. There is no vomerine process.

PALATE AND UPPER JAW.

The hyomandibular is binarticulate, the maxilla acrartete. There is little that calls for comment on the form of the arch or its component bones, the details being clearly shown in the drawings.

MYODOME.

The myodome is relatively high and relatively shallow from before back. That portion of this cavity which normally lies above the basal lamina of the basioccipital bone is, in this form, completely shut off from

the anterior widely open portion by bony partitions, and is a very low cave, walls and floor being close together.

WALLS OF THE CAVUM CRANII AND OF THE OTOCRANE.

The occipital segment of the cranial floor is formed by the basioccipital behind and the exoccipital bones in front in almost equal proportions. The azygos sinus is widely open and occupies the full width and the greater part of the depth of the dorsum of the basioccipital bone. The whole of the mesotic segment of the floor is made good by the basicranial obturator membrane. The prootic segment is short and constituted as usual by the horizontal lamina of the prootic. There is no prepituitary bony floor, the basisphenoid being apparently not developed. The lateral cranial fenestra is very large, reaching right to the roof. The postotic wall occupies the longitudinal plane of the skull as it arches over to meet its fellow on the other side. The preotic wall is nearly flat, there being but mere indications of the temporal and trigemino-facialis fossæ.

There is a greater amount of persistent cartilage in the outer wall of the otocrane than is usual, so that on the inner side practically every suture is a synchondrosis and, further than that, the cartilage invades the bones between the inner and outer tables. The usual cavities in the outer wall of the otocrane are the anterior and posterior ampullary fossæ, the arcuate fossa and the saccular recesses. In the present form the two ampullary recesses are partly confluent, and there is no trace of partition between the arcuate and anterior ampullary fossae in the bony preparation. In the flesh the missing partitions are made good by cartilage. The saccular recesses are almost devoid of bony roof, and are separated in the mid line beneath the basicranial obturator membrane by a membranous partition. The anterior boundary of the arcuate fossa is clearly indicated by a ridge, which commences above on the parietal and is continued down across the pterotic and prootic. This ridge provides the anterior line of attachment of the lateral obturator membrane. The membrana spheno-obturatoria is fairly broad.

The points of emergence of nerves iii, iv, and vi have not been determined; the other nerve foramina are situated in the usual situations. The internal carotid artery interrupts the prootic synpterygoid suture in the angle behind the alisphenoid process of the latter bone.

CIRCUMORBITAL BONES.

There are only two bones of this series developed, none of the postorbital chain are present, and there remain but the two suborbitals. The anterior suborbital is articulated to the lateral process of the prefrontal already described, and firmly attached to the outer side of the labial process of the maxilla. The bone stands out and down from its attachments at an angle of forty-five degrees with the sagittal plane; the bone is therefore foreshortened in the drawing. This bone terminates in two spines, which stand forward and out over the labials

when the mouth is closed. The form of the second subocular is sufficiently well shown in the drawing.

REVIEW.

From the four descriptions above and from the work of Allis[15] it is possible to review ten scleropareian skulls. It is a surprising fact that five distinct types of skull may be recognised among these.

Type i. *Scorpaenid*. This includes the skulls of *Scorpaena*, *Sebastes*, *Neosebastes*, *Cottus* and *Ophiodon* (?).

Type ii. *Platycephalan*; includes *Platycephalus* only.

Type iii. *Synanceian*; *Synanceja* only.

Type iv. *Triglid*, *Trigla*, *Pterygotrigla*, and *Peristedion*.

Type v. *Dactylopteran*, *Dactylopterus*.

The scorpaenid skull is characterised by its generally rounded form, compact cerebral region, spiny roofing, periorbital bones and obvious latero-sensory canal system. The myodome is large and extends back under the mesotic segment of the cranial floor. The cheek armature is incomplete.

The platycephalan skull is characterised by its extreme dorso-ventral flattening, relatively large cerebral region, non-spinous covering bones, obvious latero-sensory canals, small myodome, extending only half way under the mesotic segment or terminating at the hinder end of the prootic segment of the cranial floor. The cheek armature is still incomplete, but more complete than in the last type.

The synanceian skull presents several characteristics which make its inclusion in the present company (Scleroparei) seem a *mésalliance*; much more do these characteristics appear in evidence against the inclusion of the genus in the Scorpaenidæ.

The most outstanding, and at the same time perhaps the most fundamentally important, feature of this skull is the peculiar form of the orbital region. This is regarded as of prime importance because it is intimately related to, and probably consequent on the small size of the eyes.

It would appear that on its craniological characters *Synanceja* should be made the type genus of the family SYNANCEIIDÆ.[16] The members of this family will present more or fewer of the following characters in addition to the peculiar form of the frontal bones and the associated small eyes.

Skull more or less dorso-ventrally compressed, palato-quadrate arches wide apart ventrally and the gape at right angles to the long axis of the skull with the mouth shut. Suborbital bar complete but the postorbitals missing. Hyomandibular binarticulate, maxilla acrartete. Cerebral region of the cranium compact, parietal, epiotic, and pterotic processes large and more or less coalescent, with the supratemporal standing out above them. Occipital, temporal, and dilatator fossæ ill defined. Myodome small, not extending behind the prootic segment

[15] Allis—Zoologica, Heft. 57, 1910, pp. 1-212.

[16] Since writing this I have found that Tate Regan (Ann. Mag. Nat. Hist., (8), xi, 1913, pp. 173-175) has already done as suggested.

of the cranial floor. Opisthotic, basisphenoid, and postfrontal bones wanting. Synpterygoid without a vomerine process.

The triglid skull presents the same contours as the scorpaenid; covering bones are characteristically shagreened, not spiny, and the latero-sensory canals are well concealed. The myodome is large and extends back into the basioccipital bone; it may open behind on to the inferior surface of that bone. The cheek armature is complete.

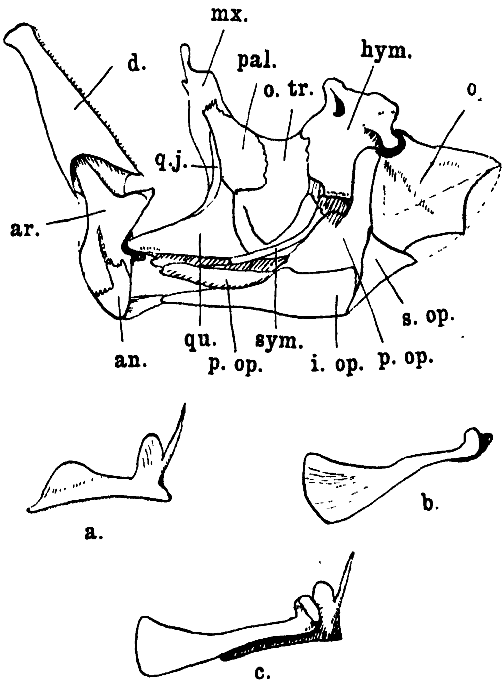

Fig. 15. Palato-quadrate arch and lower jaw of *Synanceja horrida*. *a* the premaxillary labial; *b* the maxillary labial; *c* the two labials in position.

The dactylopteran skull presents a general resemblance to the triglid; the covering bones are not spiny and are pitted instead of shagreened, and the latero-sensory canals are concealed. The cheek armature is not quite complete, but it is more firmly attached than in the triglid type. The upper scapular elements are very firmly attached to the posterior elements of the skull, and, being expanded in the same plane as the dorsal covering bones, with them constitute a remarkable cuirass which extends back well beyond the occiput. Along the base of the cranium the orbital and preorbital regions are markedly expanded.

No. V. A Discussion on the Maxillo-ethmoid Articulation in the Skulls of Bony Fishes.

The variations in the mode of articulation of the maxilla in the four genera describedin No. IV. of these studies, and in the related forms described by Allis (*loc. cit.*) may be made the basis of a general discussion on the maxillo-ethmoid articulation in the teleostome skull.

Be it noted at the outset that in all the forms which will be here passed in review (with the exception of *Neosebastes*) the pre-ethmoid cornu (Swinnerton[17]) is presented on the surface of the skull, between the premaxilla below and in front, and the mesethmoid above and behind.

In *Platycephalus* a small spur is developed on the inner side of the proximal end of the labial process of the maxilla. This spur, surrounded by fibro-cartilage, articulates with the pre-ethmoid cornu. Well back on the dorsum of the bone a small tubercle marks the gathering point of the mass of fibres which attach the maxilla to the under side of the body of the prefrontal. No articular face is discoverable on either bone in this location.

In *Pterygotrigla* there is no spur, but in the same position a small facet is present. This facet articulates with the pre-ethmoid cornu. There is no massive attachment to the under side of the prefrontal, but the postero-median and dorsal corner of the bone is attached, along with the first suborbital, to the inferior margin of the body of the prefrontal.

In *Neosebastes* a facet at the root of the labial process faces upward and backward to articulate with the anterior facet on the prefrontal; behind this a smaller facet on the postero-median corner of the body articulates with the posterior maxillary facet on the inner corner of the flattened portion of the body of the prefrontal. It must be remarked that *Neosebastes* is peculiar among the Scleroparei here reviewed in that the ethmoid cartilage does not present on the exterior of the skull, and that the anterior maxillary facet on the prefrontal occupies almost precisely the situation of the pre-ethmoid articulation in the other forms. Further the prefrontal is a parethmoid ossification.

In *Synanceja* the well developed tubercle on the body of the maxilla to the inner side of the root of the labial process articulates with the anterior corner of the prefrontal just behind the tiny peeping pre-ethmoid cornu. The strong underlying ligament is attached to the periphery of the "port-hole" through which the cartilage peeps. The median edge of the bone is attached along its length to the body of the prefrontal by a band of fibrous tissue, but this attachment is not in any way homologous with the stout attachment of *Platycephalus*, but is similar to that of *Pterygotrigla*. It is, in fact, the fore end of the fascia which floors the orbit and gives attachment to many of the fibres of the levator arcus palatini muscle.

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[17]Swinnerton—Quart. Jour. Micro. Sci., xlv., 1902, p. 514.

In *Scorpaena* Allis describes and figures a maxilla (he terms it the palatine, in conformity with the old interpretation of the piscine palate) which is in every way similar to that of *Neosebastes*, but the anterior articulation is with the pre-ethmoid cornu, which he terms the " anterior palatine process of the ethmoid cartilage."

In *Cottus*, according to Allis, the anterior and posterior ethmo-maxillary articulations are both wanting. There is, however, a small dorsomedially directed process at the base of the labial process which is "strongly bound by tissue to the lateral edge of the ethmoid cartilage, but does not have articular contact with that cartilage." Though there may be no articular cavity, there can be no question that this is strictly the homologue of the anterior ethmo-maxillary articulation of other forms. In *Scorpaenichthys* (Allis, p. 109) the process is large and articulates with the pre-ethmoid cornu ; no mention is made of a posterior articulation.

In *Trigla* Allis describes an anterior articulation of the prevailing type with the pre-ethmoid cornu, and a probable articulation with the antero-ventral corner of the body of the prefrontal.

In *Peristedion* Allis describes again the prevailing type of anterior articulation, but it is quite clear from his description that the posterior articulation is absent.

In *Dactylopterus*, according to Allis, there is on the internal surface of the base of the labial process of the maxilla " a V-shaped groove . . . (which) articulates with the anterior edge of the lateral process of the vomer, and possibly also with adjacent portions of the corresponding edge of the pedicle (body) of the ectethmoid " (prefrontal). The dorsal edge of the body of the maxilla is attached along with the " dorsal edge of the ' entopterygoid ' (palatine) immediately posterior to it " to the ventral surface of the prefrontal by strong tissue, which is apparently the anterior part of the subdermal palatal facia, as in *Pterygotrigla* and *Synanceja*.

It may be remarked that in all those forms in which the maxilla is provided with a palatine lamina behind the normal situation of the posterior ethmo-maxillary articulation, the medial edge of the lamina is attached to the body of the prefrontal or synpterygoid near the mid ventral line by a strong sheet of fascia, which continues the palatal arch to the mid line. In the absence of the posterior maxillo-ethmoid articulation this fascia becomes strengthened in front and is continued right up to the vomero-maxillary and anterior ethmo-maxillary ligaments. When the posterior articulation is present and is approximated to the mid line, as in the majority of the Acanthopterygii, the fascia becomes weaker where it spreads out below the peri-articular ligaments. In those forms in which the anterior and posterior maxillo-ethmoid articulations are separated by an appreciable distance, or when the posterior joint is situated on the dorsum of the body or palatine plate of the maxilla, the fascia is continued forward as though there were no joint, but in such cases there is no marked strengthening of the fascia in its forward end.

The fascia in question is of very general occurrence throughout the whole of the bony fishes, being absent only in forms such as the Mormyridæ[18] and Symbranchii, in which the bones of the palate are directly attached to the synpterygoid, more or less completely abolishing the subocular vacuity, and even in these forms there is usually present a small portion of the fascia at the hinder end of the palate.

It may be usefully designated the *palatine fascia.*

We may recognise both primary and secondary attachments of the maxilla to the fore end of the cranium. The primary attachments are the ethmo-maxillary articulations, or fibro-cartilaginous unions. The secondary attachments are the maxilla-vomerine ligament and the anterior end of the palatine fascia, and at times a prefronto-maxillary ligament behind the posterior primary joint.

Ridewood says of *Mormyrops* that the maxilla is " small and fused on to the side of the vomer." Though I have not had the opportunity of examining *Mormyrops*, in view of all the facts before us, it may be said with confidence that it is with the anterior cornu of the ethmoid that the maxilla is fused. There is no posterior maxillo-ethmoid articulation. The condition is a primary acrartete union, but for this solid fusion, which also occurs in some other forms, the term *synartete* is now proposed.

Returning now to the variations observed in the ten scleropareian genera reviewed, *Platycephalus, Neosebastes, Scorpæna,* and *Peristedion* present the disartete, whilst the remaining six genera present the acrartete condition. A comparison of *Neosebastes* and *Scorpæna* will show that the articulations are absolutely homologous, although in the former the anterior articulation is with the anterior corner of the frontal bone, whilst in the latter it is with the anterior cornu of the ethmoid. In *Platycephalus* the elongation of the snout has separated the two articulations, producing a condition exactly paralleled in *Esox.* Here a comparison with *Neosebastes* must convince one that the two articulations are still homologous. This is in accord with Swinnerton's conclusions.

Whilst the two articulations or unions of the disartete condition are always completely homologous, there are nevertheless two distinct varieties in the adult skull. In the one variety the articulations are both with the same bone, in the other they are not. Believing, with Swinnerton, that concise designations are desirable in this connection, I propose to designate the former variety *monobisartete* and the latter *dibisartete.*

The great majority of the Acanthopterygii are monobisartete.

Swinnerton[19] assigned a good deal of taxonomic value to the character of the ethmo-maxillary articulation, and made the statement that " notwithstanding all the changes of form which the head undergoes

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[18] Ridewood—Jour. Linn. Soc. (Zool.), xxix, 1904, pp. 188-215.

[19] Swinnerton—*loc. cit.*, p. 556.

among the Acanthopterygii . . . the double articulation is retained." *Scorpaena*, *Neosebastes*, and *Synanceja* are at present placed together in the Scorpaenidæ. The first is dibisartete, the second monobisartete, and the third is acrartete. *Trigla*, *Pterygotrigla*, and *Peristedion* are placed together in the Triglidæ. The first is dibisartete and the other two are acrartete.

As my studies in ichthyology have been confined to the anatomy of the head, I leave this question without further comment.

AN ACCOUNT OF AUSTRALIAN ATYIDAE.[1]

By

Dr. Jean Roux, Curator at the Natural History Museum, Basle, Switzerland.

During the study of the freshwater carcinological materials from New Caledonia[2] I asked Dr. C. Anderson, Director of the Australian Museum in Sydney, to send me comparative materials of the family Atyidae from Australia.

Thanks to the kind assistance of my colleague, the late Mr. A. R. McCulloch, I have been able to study the Atyidae of the Australian Museum collected in this continent. I here wish to express my gratitude to these two gentlemen for their kindness.

As Australian Atyidae are very rarely mentioned in the carcinological literature, I consider it useful to publish the results of my investigations. I have been able to distinguish in the collection two new species, one belonging to the genus *Paratya* (*P. howensis*) and another to the genus *Caradina* (*C. mccullochi*); besides these I can mention the presence in Australia of two varieties of *C. nilotica* (var. *meridionalis* J. Roux, and var. *aruensis* J. Roux). The former also inhabits New Caledonia,[2] while the latter was described by me from the Aru Islands.[3] The species examined in this paper come from the mainland of Australia, Norfolk Island and Lord Howe Island.

The following is a list of the species :—

Paratya (*Paratya*) *australiensis* Kemp.
Paratya (*Xiphatyoida*) *norfolkensis* Kemp.
Paratya (*Xiphatyoida*) *howensis* n. sp.
Caridina typa Milne Edwards.
Caridina nilotica, var. *meridionalis* J. Roux.
Caridina nilotica, var. *aruensis* J. Roux.
Caridina serratirostris de Man.
Caridina mccullochi n. sp.

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[1] Since the completion of this paper the author has finished and published a work (referred to in footnote [2]) on the Decapoda of New Caledonia which has some bearing on the facts contained herein, and is frequently referred to by him. Almost simultaneously with the appearance of Dr. Roux's New Caledonian report (1926) Dr. Calman published a paper on some freshwater prawns (Atyidae) collected in Queensland by Capt. G. H. Wilkins (Ann. Mag. Nat. Hist. (9), xvii, Feb., 1926, p. 241). A critical examination of this work, however, suggests that its contents do not conflict in any way with Dr. Roux's present contribution.—Editor.

[2] Roux—Crustacés décapodes d'eau douce de la Nouvelle-Calédonie *in* Fr. Sarasin and J. Roux, Nova Caledonia, Zoologie, iv, 2, 1926.

[3] Roux—Abhand. d. Senck. Naturf. Ges. Frankfurt, a/M., xxxv, 3, 1919, p. 321.

The species now known from the mainland of Australia are as follows:—

1. *Paratya* (*Paratya*) *australiensis* Kemp.

Queensland:—Burnett River (Ortmann, 1894).[4]

New South Wales:—Clyde, near Sydney (Kemp, 1917).[5] Pallal, Horton River near Bingara; North Yanco, Narrandera; Jamberoo, South Coast; near Singleton; Duggan's Gully Creek, Upper Chichester, near Dungog; Norton's Basin, Nepean River; Prospect Reservoir, near Parramatta; creek at Middle Harbour, Port Jackson; Marrickville, near Sydney (Roux, this paper). Without precise locality (Thomson, 1903).[6] Parramatta Park (Whitelegge, as *Palaemon* sp., 1889).[7]

South Australia:—Sturt Creek, near Blackwood, Adelaide (Roux, this paper).

Victoria:—Melbourne (Bouvier, 1905)[8]; without precise locality (Thomson, 1903).[6]

2. *Caradina typa* M. Edw.

Queensland:—Cooktown; Dunk Island (Roux, this paper).

3. *Caridina nilotica*, var. *meridionalis* J. Roux.

Queensland:—Burnett River (Ortmann, as *C. wycki* 1894,[4] and Roux, this paper); Cooktown, Cairns (Roux, this paper).

4. *Caridina serratirostris* de Man.

Queensland:—Cairns (Roux, this paper).

5. *Caridina mccullochi*, n. sp.

New South Wales:—Pallal, Horton River, near Bingara; creek at Port Macquarie (Roux, this paper).

6. *Atya scabra* Leach.

Victoria:—No precise locality (Bouvier, 1905).[8]

7. *Atya striolata* McCulloch & McNeill.

New South Wales:—Norton's Basin, Nepean River (McCulloch & McNeill, 1923); Woronora River, tributary of George's River (as a footnote to this paper).

Genus PARATYA *Miers*.

In a work to be shortly published on the freshwater Decapoda from New Caledonia (see footnotes [1] and [2]), I have explained in detail the reasons which lead me to divide this genus into two distinct sub-genera, to which I have given the names of *Paratya* s. str. and *Xiphatyoida*. I will resume the differentiating characters of these two groups.

Sub-genus Paratya s. str. This group includes the species known up to date, viz.:—*P. compressa* (de Haan) of Japan and Adenare near Flores, *P. curvirostris* (Heller) of Assam and New Zealand, and *P. australiensis* Kemp of Australia. These species are characterised by the elongated carpus of the chelipeds, especially on the second pair; the carpus of these last legs is but very slightly excavated in front. The

[4]Ortmann in Semon's Zool. Forschungsr. Austr., v, (Denkschr. med.—naturw. Gesellschaft, Jena, viii), 1894, p. 10; and Proc. Acad. Nat. Sci. Philad., 1894, pt. 3, p. 400 (for references to Ortmann's Burnett River record of *C. nilotica*, var. *meridionalis* as above, see pages 11 and 405 respectively).

[5]Kemp—Rec. Indian Museum, xiii, 5, 1917, p. 304.

[6]Thomson—Trans. Linn. Soc. Zool., London (2), viii, 1903, p. 449.

[7]Whitelegge—Journ. Roy. Soc. N.S. Wales, 1889, p. 320.

[8]Bouvier—Bull. Sci. France et Belgique, xxxix, 1905.

digits of the chelipeds are provided with long and thin stylets. The fifth dactylopodite is characterised by the possession of only one terminal claw, which is larger than the lateral spines.

Sub-genus Xiphatyoida:—This group includes some species which are characterised by the noticeable shortness of the carpus of both pairs of chelipeds, those of the second pair having a deep and well marked excavation in front. I sometimes also notice in these species the occasional presence of large, strong nails at the extremities of the fingers; the fifth dactylopodite always possesses, next to the terminal claw, one or two other sub-terminals, which are also bigger than the lateral spines of the digit. This sub-genus includes to date the following species: *P. norfolkensis* Kemp (Norfolk Island); *P. howensis* n. sp. (Lord Howe Island); and three species from New Caledonia—viz.:—*P. bouvieri* J. Roux with its variety *ngoiënsis* J. Roux, *P. caledonica* J. Roux and *P. typa* J. Roux.

The species of this second group are to be regarded as more evolved than those of the first subdivision.

PARATYA (PARATYA) AUSTRALIENSIS (*Kemp*).

(Table A).

1894. *Miersa compressa* Ortmann, Jenaische Denkschrift viii (Semon's Forschungsreisen in Australien,) p. 10.

1902. *Xiphocaris compressa* Thomson, Trans. Linn. Soc. London (2) viii, p. 449.

1904. *Xiphocaris compressa* Bouvier, Bull. Mus. Hist. Nat. Paris, p. 129.

1905. *Xiphocaris compressa* Bouvier, Bull. Scient. France & Belgique, xxxix, p. 61, fig. 1.

1909. *Xiphocaridina compressa* Bouvier, Bull. Mus. Hist. Nat. Paris, p. 329.

1912. *Xiphocaridina compressa* Kemp, Rec. Indian Mus., Calcutta, vii, p. 114.

1917. *Paratya australiensis* Kemp, Rec. Ind. Mus., Calcutta, xiii, p. 303, fig. 5.

Localities.—New South Wales:—Pallal, Horton River, near Bingara, December, 1909, collected by the late A. R. McCulloch; North Yanco, Narrandera, 1910; Jamberoo, south coast district, presented by Prof. L. Harrison, 1913; near Singleton, 1st August, 1918, descended with rain; Duggan's Gully Creek, Upper Chichester, near Dungog, Sept., 1921, collected by A. Musgrave; Norton's Basin, Nepean River, presented by the late A. R. McCulloch, 1913; Prospect Reservoir, near Parramatta, collected by the late R. Etheridge, 1902; creek at Middle Harbour, Port Jackson, January, 1911, collected by the late Dene B, Fry; from a disused potter's pit in Marrickville, near Sydney, April. 1924, collected by F. A. McNeill.

South Australia:—Sturt Creek, near Blackwood, Adelaide, collected by E. Le G. Troughton, March, 1920.

The numerous specimens before me show that this species, which is spread over a great part of the Australian continent, varies considerably,

TABLE A.

TABLE OF MEASUREMENTS OF *Paratya australiensis* KEMP.

		Horton River female ovig.	Nepean River female ovig.	North Yanco female ovig. (rostrum short)	Parramatta female ovig.	Adelaide female	North Yanco male (rostrum long)	Port Jackson male
	Total length	27 mm.	25 mm	25 mm.	32 mm.	24 mm.	25 mm.	26 mm.
1st Chelip.	Carpus, length : breadth	2	2.4	2.6	1.6	1.83	2.2	2.8
	Chela, l. : br.	3.2	3	3	2.5	2.6	2.6	3.2
	Chela, dact. : palma	0.78	0.87	1.1	0.6	0.9	0.6	1
2nd Chelip.	Carpus, l. : br.	7	7	7.5	5.1	5.6	7.4	6.6
	Chela, l. : br.	4	4	3.7	3.1	3.2	3.5	3.4
	Chela, dact. : palma	1	1.2	0.78	1.1	1.36	0.87	1.5
III Pereiop.	Prop. : dact.	3.8	4.2	3.1	4.2	4	4	4
	Dact., length : breadth	3.6	4.2	5.4	3.6	3.55	4.3	3.9
	Spines	9	12	11	10	11	10	9
V Pereiop.	Prop. : dact.	3.1	3.4	2.5	3	3.2	3.1	3.8
	Dact., length : breadth	4.5	4.7	5.7	4.8	4.2	5.2	4.3
	Spines	74	69	80	75	64	69	52
Eggs	length	0.52-0.57	0.66-.069	0.66-0.69	0.82-0.85	—	—	—
	breadth	0.28-0.31	0.41-0.44	0.39-0.42	0.49-0.52	—	—	—

either in the form, the dimensions and armature of the rostrum, or in the proportions of the legs and the size of the eggs.

Notwithstanding the differences that are found among the specimens from the diverse localities of New South Wales and South Australia, I have not been able to separate these samples into peculiar regional races. Our knowledge of the Atyidean fauna is still too poor and at present it appears impossible on account of the intermediate forms which connect the very different specimens to establish very sharp divisions into varieties. I have found individuals with a short rostrum, others with a long one, and others again with a very long rostral appendage. These variations do not agree with those of the proportions of the legs or with the size of the eggs. Further, I have not been able to find marked differences in the form of the first male pleopod. I will therefore describe all these specimens under the specific name used by Kemp (*loc. cit.*). In his account of the Atyidae of the genus *Paratya*, this author mentions the great variations in the proportions of the legs, but I have found that they are greater than he has indicated.

The specimens from Horton River, near Bingara, have the rostrum as long as the antennular peduncle and armed with numerous teeth, two or three proximal of which are placed on the carapace. In one female specimen I have noted the rostral formula $\frac{(2)25}{5}$. In the table of measurements of this species (see p. 240) will be found the relations obtained by the measurements of the joints of the chelipeds and legs. These proportions are contained in the limits indicated by Kemp. The eggs of this female are 0.52-0.57 mm. long and 0.28-0.29 mm. wide; those of another female were of the same length, but slightly wider, 0.31 mm.

The specimens from North Yanco, Narrandera, may be divided into two groups. In the first, which includes two males and one female without eggs, the rostrum exceeds the extremity of the antennular peduncle and reaches in front as far as the antennal scale; the rostral formulae stated are: $\frac{(2)29}{8}$, $\frac{3(26)}{5}$, $\frac{(2)23}{5}$. I have mentioned in the table of measurements the totals obtained for a male specimen of about 25 mm. still possessing all its legs.

In the second group, which includes the other specimens from the same locality, the rostrum is much shorter; pointed downwards, it reaches hardly to the extremity of the first segment of the antennular peduncle and is sometimes even still shorter. In these specimens the teeth are fewer and none of them are situated on the carapace. The rostral formulae are as follows: $\frac{(0)12}{2}$, $\frac{(0)12}{3}$, $\frac{(0)13}{2}$, $\frac{(0)15}{1}$, $\frac{(0)15}{2}$, $\frac{(0)18}{3}$, The proportions of the limbs are given in the table of measurements for an ovigerous female of about 25 mm. length.

The carpi of the chelipeds are very long, but this is a character that is found also in *P. australiensis* with normal rostrum (e.g., from Horton River); the only point that would seem peculiar is the shortness of the dactylus V, but specimens with a long rostrum show the same character. The eggs of the female with a short rostrum are 0.66-0.69 mm. long and

0.39-0.42 mm. broad, so they are a little bigger than those of the females from Horton River, but we shall see below that they are, however, smaller than those of the females with a normal rostrum from Parramatta. The shortness of the rostrum does not seem to be a sufficient reason for separating these specimens from the others.

The specimens from Jamberoo (south coast district of New South Wales) show the normal characters of this species. The rostrum is longer than the antennular peduncle; it reaches sometimes beyond the end of the scaphocerite. The upper border carries 7-30 teeth, the two proximal of which are situated on the carapace; the lower border bears 4 to 9 teeth; a female without eggs is 26 mm. long.

From Singleton there are three typical specimens, the largest of which is a female without eggs 31 mm. in length. The very long rostrum reaches beyond the scaphocerite, and its upper border carries a great number of teeth (29-36); the lower border has 8-11 teeth. In this female the rostrum is 7 times as long as broad.

The only specimen from Duggan's Gully Creek, near Dungog, has a damaged rostrum, but judging from the part remaining, it seems to be normal and to reach as far as the extremity of the scaphocerite. Two teeth are on the cephalothorax and there are 21 teeth to the point of fracture; the lower border carries 3 teeth. This specimen is about 28 mm. long.

The two females found at Norton's Basin, Nepean River, are also typical, These have the rostrum very long, reaching a little beyond the scaphocerite; the rostral formulae are: $\frac{(2)21}{7}$, $\frac{(1)20}{8}$. One of these females, of normal size, bears eggs which are 0.66-0.69 mm.long and 0.41-0.44 mm. broad. The proportions of the legs are included in the limits known for this species; they will be found in the table of measurements.

The specimens from Parramatta are well preserved. The largest female bearing eggs measures 32 mm. in length and the eggs are 0.82-0.85 mm. long and 0.49-0.52 mm. broad. They are rather numerous, but still fewer than those of the females from the Horton River; probably a certain number of them must have become detached. The rostrum in these specimens does not reach the extremity of the antennular peduncle; it reaches only to the extremity of the second segment. The teeth are less numerous than those of the typical specimens; I have counted 14 to 23 teeth on the upper border. Sometimes the two proximal teeth are situated on the carapace, at other times only one. Again, others have all the teeth situated on the rostrum. The table gives the measurement relative to a big ovigerous female specimen in this batch.

From Marrickville (a suburb of Sydney) I have examined 5 females, which are the biggest in the whole collection. They were found in a disused potter's pit and do not bear eggs. The largest specimen is 35 mm. long, the others being a little smaller (34 and 32 mm.). In these examples the rostrum is quite as long as, or even a little longer than the antennular peduncle, and the teeth are very numerous. I have noted the following formulae: $\frac{(5)36}{16}$, $\frac{(3)33}{12}$, $\frac{(4)31}{8}$, $\frac{(3)29}{13}$.

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The specimens from a creek at Middle Harbour, Port Jackson, are typical. In most of these the very long rostrum reaches beyond the antennular peduncle, and the number of teeth on the upper border varies from 21 to 32 ; in some examples there are 1-3 teeth on the carapace, in others (especially the younger ones) all the teeth are situated on the rostrum. The lower border of the rostrum carries 3-8 teeth. One female without eggs measures 26 mm. in length ; the proportions of the length of the legs can be found in the table.

In the specimens collected at Sturt Creek, near Blackwood, Adelaide, the rostrum is very long, reaching beyond the antennular peduncle. It has 19-24 teeth on the upper border, and these are all situated (with one exception) on the rostrum. Some individuals have the distal quarter of the upper rostral border devoid of teeth. The lower border carries 1-7 teeth that are often only very slightly distinguishable. The table gives the measurements of the limbs of a female specimen.

PARATYA (XIPHATYOIDA) NORFOLKENSIS *Kemp.*

(Table B.)

Paratya australiensis subsp. *norfolkensis* Kemp.

I have examined some individuals of this species, the larger ones coming from the west coast of Norfolk Island, the smaller collected on the opposite coast. The authors who have studied this species (Grant and McCulloch,[9] and Kemp[10]) have also noticed the difference in size between the specimens from the two opposite coasts, but consider them, with reason, as belonging to one and the same species.

The differences noted in the length of the rostrum are not as constant as one might at first think, and the measurements taken of the appendages of the two forms show about the same proportions. I have already explained the reason why I separate this species from those living on the Australian continent.

As in the Australian species, the antennular bridge bears a high, cutting keel. The proportion of the length of the antennular peduncle (measured from the orbital notch) and the postorbital length of the cephalothorax varies between 0.66 and 0.76 in both races. The rostrum is similar in shape to that of *P.* (*P.*) *australiensis*; its length is variable, but is never less than the length of the antennular peduncle. In most individuals it is as long as the scaphocerite ; it is bent downwards, more in adult specimens than in young ones. On its upper border it carries usually 26 to 29 teeth or more (34 teeth have even been counted), which form an uninterrupted series from the base to the apex. In the young specimens the rostral teeth are fewer, only 17-24 being present. The 4 or 5 proximal teeth of the adults are situated on the carapace behind the orbital notch ; in the young these number only 2-3. On the lower border there are 3-6 teeth. As Kemp (*loc. cit.*) has already shown, the carpus of the chelipeds, especially that of the first pair, is much shorter than in the Australian species ; the anterior excavation is deeper, more developed, and some-

[9]Grant and McCulloch—Proc. Linn. Soc. N.S. Wales, xxxii, 1907, p. 156.
[10]Kemp—Rec. Indian Museum, Calcutta, xiii, 1917, p. 305.

TABLE B.

TABLE OF MEASUREMENTS OF

		Paratya (*X.*) *norfolkensis* Kemp.				*Paratya* (*X.*) *howensis* n. sp.		
Sex.	Total length	After Kemp	Female 26 mm. W. side	Female 20 mm., E. side	Male 16 mm., E. side	Female, ab., 20 mm.	Female 18 mm.	Male 15 mm.
	Rostr. Formula	$\frac{(2\text{-}5)\ 21\text{-}32}{3\text{-}8}$	$\frac{(5)\ 27}{6}$ = ant ped.	$\frac{(5)\ 33}{5}$ > scaph.	$\frac{(4)\ 28}{5}$ = ant ped.	– –	$\frac{(1)\ 16}{5}$ < ant ped	$\frac{2)\ 15}{2}$ < ant ped.
1st Chelip.	Carpus, length : breadth ...	female 1.3-1.6; male 1.7-1.9	1.4	1.45	1.4	1.2	1.1	1.1
	Chela, length : breadth ...	——	2.5	2.36	2.2	2.25	2.17	2
	Chela, dact : palm	——	0.58	0.62	0.75	0.63	0.66	0.62
2nd Chelip.	Carpus, length : breadth ...	4.2-4.9	4.8	4.52	4	3.75	4	4
	Chela, length : breadth ...	——	3.1	3	3.1	3.2	2.7	2.7
	Chela, dact. : palm	——	1.19	1.1	1.1	1.28	1.06	1.4
III. Pereiop.	Prop. : dactyl.	female 4.3-5.2; male 3.7-3.9	4.5	4.8	3.8	4.3	4.2	4
	Dactyl., length : breadth ...	2.1-2.7	3.1	3	3.5	3.3	3.1	4
	Spines	6-8(9)	7	7	7	8	6	6
V. Pereiop.	Prop. : dactyl.	4.2-4.4; male 3.9	5	4.1	3.8	4	3.7	3.1
	Dactyl., length : breadth ...	2.4-2.8	3	3.1	4	4	3.88	4.1
	Spines	35-43 + 2-3	42 + 3	33 + 3	36 + 3	53 + 3	43 + 3	32 + 2
Eggs	... ...	——	——	——	——	——	– – –	——

times extends for nearly half the length of this segment of the limbs. This same character is found in the species inhabiting Lord Howe Island, and also in those of New Caledonia. I have measured two females (a big one and a small one) and one male specimen of the last race, but have not been able to find that the differences between the two sexes are as marked as Kemp has indicated. The relations obtained in the measurements of these three individuals mentioned above are indicated in the table facing page 243.

The carpus of the first chelipeds is more than twice as broad as long and is deeply excavated in front. The chela is heavy and massive (ratio: 2.2-2.5); its surface is embossed and the finger is always shorter than the palm (ratio: 0.58-0.75).

The carpus of the second cheliped is also shorter and excavated more deeply than in *P.* (*P.*) *australiensis*. The ratio length: breadth varies, in the measured specimens, from 4 to 4.8. The chela is more slender than in the first legs, being about 3 times as long as broad; the dactylus is slightly longer than the palmar portion. I have found that the terminal armature of the finger of the first chelipeds is noticeably different to those of the Australian species. The dactyli are armed with 3 large yellow nails instead of the slender stylets already mentioned for *P.* (*P.*) *australiensis*. The longest nail is placed at the extremity of the dactylus, the two others a little in front, on the right and on the left of the inner surface of the finger. This conformation exists in the two Norfolk Island races, but in the smaller examples these nails are proportionately shorter and broader (ratio 2.5-3, instead of 5 in the larger race).

At the extremity of the dactyli of the second chelipeds, there are only 3 slender stylets, which are placed very close to one another, the median one being the longest. These stylets show a slight difference in the two races. In the smaller specimens the terminal stylet is a little broader than the two others (7 times as long as broad, instead of 10). In the larger race the form of the stylets is nearly the same, but they are proportionately longer (13-14 times).

Like Kemp, I have observed that the propodus of the third and of the fifth leg is proportionately a little longer in the male than in the female ($\frac{\text{Prop.}}{\text{Dact.}}$ III.—3.8 male, and 4.5-4.8 female; $\frac{\text{Prop.}}{\text{Dact.}}$ V.—3.8 male and 4.1-5 female). The dactylus III bears 7 spines, and that of the fifth leg 33-42 spines, in addition to 3 claws, which are larger than the spines; the terminal one of these claws is the largest.

The presence of the claws distinguishes at a glance the species belonging to the sub-genus *Xiphatyoida*.

Epipodites are present at the base of all the pereiopods with the exception of the fifth. The dimensions of the specimens before me are about the same as those given by Kemp. None of the females bear eggs.

PARATYA (XIPHATYOIDA) HOWENSIS *n. sp.*

(Table B.)

Locality:—Big Creek, Lord Howe Island (collected, the late A. R. McCulloch, 3rd March, 1912).

The specimens lying before me are nearly of the same size as the small race from Norfolk Island, 18 mm.; the males are a little smaller, 16 mm.

This species has a well developed keel at the antennular bridge. The proportion of the antennular peduncle and the postorbital portions of the cephalothorax varies from 0.7 to 0.78. In all the specimens the supraorbital spine is well developed. This is not always the case in the infraorbital one, which is missing in half of the examples; in these the infero-orbital border is broadly rounded.

The rostrum is generally a little shorter than the antennular peduncle or quite as long. It is horizontal and possesses on its upper border 15-18 regularly implanted teeth, the 2 or 3 proximal ones being situated on the carapace. The lower border carries from 2 to 5 teeth, which are much larger and more inclined than the upper ones. The antennular acicle is very long and exceeds the base of the second antennular segment.

The chelipeds are massive, especially those of the first pair. In these latter the carpus is very short and deeply excavated in front; in the measured specimens (2 females and one male) the ratio $\frac{\text{length}}{\text{breadth}} = 1.1\text{-}1.2$ The chela is very broad in comparison with its length, and the surface of its palm is embossed; the proportion of the length to the breadth varies from 2 to 2.25. The mobile finger is very short and is only 0.63-0.66 of the length of the palm. As in the species from Norfolk Island and from New Caledonia, the finger of the first chelipeds has short and broad nails at its extremity; the median one is about 2.5 times as long as broad, while the others are nearly as long but are a little narrower.

The carpus of the second cheliped is much shorter than in the species *P.* (*P.*) *australiensis* and *P.* (*P.*) *curvirostris*. As already stated above, this character is to be found also in *P.* (*X.*) *norfolkensis* and the New Caledonia forms. In the specimens measured I have obtained the following proportions: $\frac{\text{length}}{\text{breath}} = 3.75\text{-}4$. The anterior excavation is very well marked and more accentuated than in the species of the sub-genus *Paratya*. The chela is not as thick as those of the first chelipeds, the ratio length: breadth varying from 2.7 to 3.2; the mobile finger is a little longer than the palmar portion (ratio: 1.1-1.4). The dactyli are armed at their extremities with 3 small stylets (ratio: length: breadth, 5-5.5); they are rather indistinct among the setae.

The propodite of the third legs is 4-4.3 times as long as the dactylus. This last segment is 3.3-4 times as long as broad, and has 32 to 53 lateral spines followed by 2-3 large terminal claws, the last of which is the strongest.

Epipodites are well developed at the base of the four anterior pairs of pereiopods. None of the females was ovigerous.

This species is very nearly related to *P.* (*X.*) *norfolkensis* Kemp, but differs from it in the form and dentition of the rostrum and in the shorter carpus I. It is also related to *P.* (*X.*) *caledonica* Roux, from south New Caledonia, but this last species has a much shorter rostrum and a much smaller number of spinules on the fifth dactylus (13-23).

Genus CARIDINA *M. Edw.*

CARIDINA TYPA *M. Edw.*

Localities.—*Queensland*:—Creek at Cooktown, May, 1918, collector A. R. McCulloch, 7 specimens (collected with *C. nilotica*, var. *australis* Roux), Aust. Mus. Reg. No. P.4296, part; Dunk Island, 1 specimen presented by the late E. J. Banfield, 1912, Aust. Mus. Reg. No. P. 3212.

The rostrum has the typical form. In some individuals it reaches as far as the end of the basal segment of the antennular peduncle; in others it is slightly longer. In all specimens it is bent downwards and the upper border is devoid of teeth; the lower border has 2-5 teeth. The antennular bridge has a low but distinct carina.

The epipodites are well developed at the base of the four anterior pairs of pereiopods. The largest female is 24-25 mm. long. None of the specimens bears eggs.

CARIDINA NILOTICA *var.* MERIDIONALIS *Roux.*[11]

Localities.—*Queensland*:—Creek at Cooktown, May, 1918, collector A. R. McCulloch, 10 specimens (found with the preceding species, Aust. Mus. Reg. No. P.4296, part; Cairns, presented by F. H. Taylor, 1918, 7 specimens (collected with *C. serratirostris* de Man), Aust. Mus. Reg. No. P.4233, part; Eidsvold, Burnett River, coll. Dr. T. L. Bancroft, 1911, 5 specimens.

The specimens possess the principal characters of *Caridina nilotica*: antennular bridge without keel, preorbital length of antennular peduncle being 0.8 from the postorbital length of the cephalothorax; epipodites well developed at the base of the four anterior pairs of pereiopods; rostrum mostly without teeth on the distal part of the upper border. I consider the specimens before me as belonging to the variety *meridionalis* described by me in another paper on the crustaceans from New Caledonia.[12] Although some variation occurs in the proportions of the legs, I put together in the same variety the specimens from Australia and those from New Caledonia. Only the specimens from Cooktown are well preserved. Among the largest examples there are ovigerous females of 28-29 mm. length. The rostrum has the typical shape for this species; it is usually devoid of teeth on a longer or shorter distal part of the upper border (about ⅓). This border has 16-22 teeth, the two first of which

[11]Balss, in K. Sv. Vet. Akad. Handl. lxi, 10, 1921 (Res. Dr. Mjöberg's Swedish Sci. Expd. Australia, 1910-13, xxix), p. 7 gives a reference "*Xiphocaridina compressa*" from Cedar Creek, Cairns district, N. Qld. This record may be referable to the above species or to *C. serratirostris* as determined here by Dr. J. Roux.—EDITOR.

[12]Roux, *in* Sarasin & Roux, Nova Caledonia, Zoologie, iv, 2, 1926, p. 207. [The paper in "Nova Caledonia" here referred to by Dr. Roux was only in course of preparation at the time this present contribution was written. It may therefore be discovered by readers that the proportions of *Caridina nilotica*, var. *meridionalis* do not agree as closely with those of the New Caledonian examples written upon by Dr. Roux. We must assume, therefore, that the author had more complete material for examination when he finalised his report on "Crustacés décapodes de la Nouvelle-Calédonie.—EDITOR.]

are situated on the cephalothorax. Sometimes the space between the two distal teeth is larger than that between the others. On the lower border there are 13-16 teeth, the distal ones of which are often very small. In these specimens the rostrum is very long; it reaches beyond the end of the antennular peduncle, and its extremity, turned upwards, reaches to the end of the scaphocerite.

The antennular acicle is a little shorter than the basal segment. The carpus of the first cheliped is rather short; its breadth is not twice its length (1.7-1.9). The chela is twice as long as broad and the proportion between the finger and the palmar portion is a little more than 1 : (1.1).

The carpus of the second pair of limbs is 4.4-4.8 times as long as broad anteriorly. The chela is rather elongated (2.3-2.7); the finger is always longer than the palmar portion (1.3-1.7). The propodite of the third leg is 4.2-4.5 times as long as the digit; this proportion is a little lower than in the New Caledonian specimens (4.6-5.3). The dactylus is 3.3-3.6 times as long as broad and bears 8-9 spines. In the specimens from New Caledonia the proportion is the same, but the dactylus possesses only 7 spines.

On the fifth pair of pereiopods, the proportion between the propodite and the dactylus varies from 3.8 to 4.1. The digit is 4.5-5 times as long as broad; it is armed with 51 to 66 spines.

There are 12 uropodial spines. The eggs are small and numerous (0.36-0.39 mm. long and 0.21-0.23 mm. broad). The smallest ovigerous females are about 27 mm. long. I also regard the 5 specimens from Eidsvold, Burnett River, as belonging to this variety. They are all devoid of pereiopods, but the form and proportions of the rostrum and the dimensions of the eggs are the same as in the before-mentioned individuals from Cooktown.

The rostrum reaches sometimes beyond the scaphocerite; the formulae are as follow: $\frac{(2)23+1+1}{13}, \frac{(2)23+1}{6}, \frac{(2)\ 21}{11}, \frac{(2)\ 19+1+1}{8}$. The largest specimen is an ovigerous female which is about 33 mm. long. The eggs are 0.49-0.52 mm. long and 0.29-0.31 mm. broad. These dimensions are a little above those found in the specimens from Cooktown, but I have also noticed such variations in the examples from New Caledonia.

The specimens from Cairns, Queensland, are all young; only one of these has an undamaged rostrum, which is longer than the scaphocerite. The rostral formula is $\frac{(2)\ 17+1}{11}$. None of these specimens have any pereiopods at all.

The variety *meridionalis* is connected with *gracilipes* de Man and *brevidactyla* Roux, which also have small eggs. There are many differences, though, in the form and in the proportions of the legs. The carpi I and II are shorter. On the third pair of pereiopods, the digit is relatively longer than in *brevidactyla*, but a little shorter than in the variety *gracilipes*. On the fifth pair, the dactylus is relatively longer than in *brevidactyla* and broader than in *gracilipes*.

CARIDINA NILOTICA *var.* ARUENSIS *J. Roux.*

Locality.—Queensland:—creek 40 miles S.W. of Townsville (coll. Dr. W. E. J. Paradice, R.A.N., 1924), 4 female specimens (2 badly preserved).

These specimens agree very well with those I have described from the Aru Islands.[13] The single female with eggs is — mm. long.[14] The rostrum has the typical form and reaches to the end of the scaphocerite; this distal part is slightly turned upwards. The upper border bears a proximal series of 21-23 teeth, the two first of which are situated on the carapace. One or two apical teeth are separated from the long proximal series by a short space devoid of teeth. The lower border carries 9-11 teeth.

In the proportions of the legs, as well as in the dimensions of the eggs, the specimens also agree with *C. nilotica*, var. *aruensis*.

By the female with eggs, the proportions of the legs are as follow:—Cheliped I. Carpus, length: breadth 2.6; Chela, 1. : br. 2.44; digit: palm 1.34.

Cheliped II. Carpus, length : breadth 5.3 ; Chela, 1. : br. 2.9 ; digit : palm 1.5.

The III pereiopods are absent.

At the IV leg the proportion:—propodite: dactylop. = 4. The dactylus is 4 times as long as broad and has 11 spines (the last included).

At the V pereiopod the proportion:—propod.: dact. = 3.6.

The dactylus is 4 times as long as broad and bears 45 spines. The proportions of the III pereiopod of another specimen are as follow:—Propod.: dactylus 3.7; Dactyl., length : breadth 4. Spines 11 (including the last one).

The eggs are rather few in number and rather large. They are 0.64 mm. long and 0.39 mm. broad; very different in size to those of the preceding variety of the same species.

CARIDINA SERRATIROSTRIS *de Man.*[15]

Locality.—Queensland:—Cairns, presented by Frank H. Taylor, 1918; 3 specimens (collected with *C. nilotica*, var. *meridionalis* Roux, Austr. Mus. Reg. No. P.4322, part). These specimens are unfortunately in a bad state of preservation. Nevertheless, I am able to recognise the most typical features of the species, thus making my determination certain.

In an ovigerous female of 20 mm. length, the rostrum is well preserved. The structure begins before the middle of the carapace and is

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[13] Roux—Abhandl. Senckenb. Gesellsch. Frankfurt a/M., Bd. 35, 1919, p. 321.

[14] Of the four specimens examined by Dr. Roux only two were returned to the Australian Museum, neither of them being the ovigerous female referred to here. For this reason we are not able to give the length of the last-mentioned example. The two examples in the Australian Museum, however, measure 16 and 17.5 mm., and from what is remembered of the batch of 4 specimens, they were all of about the same length.—EDITOR.

[15] Roux, *in* M. Weber, Zool. Ergebn. Reise Nierld. Ind., II, 1892, p. 382, pl. xxiii, f. 28.

turned downwards; it reaches hardly to the extremity of the second antennular segment. It is about 5-6 times as long as broad, and has on the upper border 19 teeth, the 5 proximal of which are situated on the cephalothorax. On the inferior border there are only 3 teeth. The eggs are small and numerous; they are 0.28 mm. long and 0.19-0.20 mm. broad.

In another ovigerous female with a damaged rostrum, there are 6 teeth on the carapace and the rostral carina begins also before the middle of the cephalothorax. This specimen still possesses one cheliped I. The carpus is 2.6 times as long as broad and very little excavated in front. The chela is elongated and thin, longer than the carpus. It is 2.6 times as long as broad and the digit is 1.4-1.5 times as long as the palmar portion. In this specimen also the eggs are numerous, but a little bigger than in the preceding one; they are 0.34-0.36 mm. long and 0.2-0.21 mm. broad.

A detached carpus II, found with these specimens, probably belongs to this species, in spite of its shape. It is about 6 times as long as broad; the chela is absent.

The third individual is young and devoid of pereiopods; the rostrum is nearly intact. It is directed horizontally and its formula is as follows:— $\frac{(6)24}{6}$. It is a little shorter than the scaphocerite and about 8 times as long as broad. Only the basilar segment of the antennular peduncle is present; the basilar acicle reaches to a little before the extremity of this segment. In the preceding specimens it was as long as this joint.

The three above specimens show, with small individual differences, the principal characters of *C. serratirostris* de Man. The antennular bridge is devoid of a keel; the proportions of the length of the antennular peduncle and the post-orbital length of the carapace is, in the adult examples, smaller than 0.8, being about 0.65. Epipodites are present at the base of the four anterior pairs of pereiopods. The uropodial spines are 14-16 in number. In spite of the dimensions of the pereiopod I (carpus) we can attribute these specimens to the typical form. for in the variety *celebensis*—which we (Sarasin and Roux) also found in New Caledonia, this segment is more elongated.

CARIDINA MCCULLOCHI *n. sp.*

(Table C.)

Localities.—New South Wales:—from a freshwater stream at Port Macquarie, 3 specimens collected by the late A. R. McCulloch, 1913; Pallal, Horton River, near Bingara, 6 specimens (types)—secured with *Paratya australiensis* Kemp—collected by the late A. R. McCulloch, 1909; North Yanco, Narrandera, 1910, 3 specimens (collected with *P. australiensis* Kemp).

I will describe as the types of this new species the specimens from Pallal, which are in the best state of preservation. The adult females are 28 to 31 mm. long. The antennular bridge is devoid of a keel. The proportions of the preorbital length of the antennular peduncle and the postorbital lengthof the cephalothorax varies between 0.7 and 0.8, being generally less than the latter number.

The rostrum is rather long; in the majority of the specimens it reaches the end of the scaphocerite or is even a little longer. It is at first slightly bent downwards before the orbit and afterwards directed horizontally. The length is seven times the breadth, sometimes even a little more. The upper border carries numerous teeth which occupy the whole length, but these often vary in size. The proximal series comprises small, regularly placed teeth, situated close to one another, while the distal ones are bigger, more inclined, and further removed from one another. This peculiar disposition is to be found also in *C. cognata* de Man.[16] In two specimens only the teeth are equal, and regularly distributed on the upper border; these bear respectively 29 and 32 teeth.

The number of these teeth varies from 25 to 32, the 3 first of which are situated on the cephalothorax. The proximal series is of variable length, and is formed by 22 to 25 teeth, the two first of which are a little more spaced than the ones following. The distal teeth, unequally implanted, vary in number. The lower border has 7 to 10 teeth, which are long and directed obliquely to the front; they are placed on the anterior half of this lower border.

The spine at the base of the antennular peduncle is shorter than the first segment; the spine at the base of the 2nd segment is shorter than half this segment. The infra-orbital angle of the cephalothorax is very pointed; the antero-inferior border is rounded.

The first cheliped does not reach to the extremity of the antennular peduncle, whilst the second goes a little beyond this point. Epipodites are well developed at the base of the four anterior pairs of pereiopods.

The carpus I is relatively long (2.5-3 times as long as broad); the distal excavation is very shallow. The chela is a little longer than the carpus (ratio 1.18). It is 2.2-2.6 times as long as broad. The fingers are longer than the palmar portion (1.27-1.4); their extremity is furnished with a stylet about 3 times as long as broad.

The carpus II is also elongated in shape (ratio 6-6.6). The chela is 2.6-3.3 times as long as broad, and the fingers are a little longer than the palm (1.4). The proportions of the chela and the carpus vary from 0.68 to 0.7.

The length of the dactylus III is contained 3.7-4.1 times in the propodite of this pereiopod; it is 4-4.75 times as long as broad and is armed with 9-10 spines (the terminal one included).

The propodite V is 3-3.1 times as long as the dactylus, which is slender and elongated. Its length is 5.3-5.7 times its breadth (this last number is based on a non-ovigerous female which is a little smaller than the others). The dactylus bears 55-57 spines. The uropodial spines are 12-14 in number.

The telson is armed on its upper surface with 5 pairs of spines, and has on the distal border 4 pairs of spines of the same length. The eggs are small and numerous. They are (in a female of 30 mm. length) 0.5-0.53 mm. long and 0.33-0.35 mm. broad.

I include in this species three young specimens from Port Macquarie, which are badly preserved. The rostral formula is nearly the same as in

[16] de Man, Zool. Jahrb. (Syst.), xxxviii, 1915, p. 397, Taf. xxviii, f. 3-3g und 4-4b.

the preceding specimens, whilst the number of teeth is smaller. There are 12-15 teeth on the upper border of the rostrum, the two proximal of which are situated on the cephalothorax; the intervals between the 2 or 3 proximal ones are a little greater than the others. The rostrum reaches in front the $\frac{1}{3}$ or the $\frac{1}{2}$ of the last segment of the antennular peduncle.

The proportions of the segments of the pereiopods in one of the specimens are a little different to those which are given above. But this specimen is still a young one and cannot be compared exactly with the adult. The carpus of the first cheliped is, notwithstanding, slender (ratio 2.3). It is shorter than the chela, which is 2.2 times as long as broad; the finger is not longer than the palmar portion. The chelipeds of the second pair of pereiopods are both absent.

At the third pereiopod, the proportion of the propodite and the dactylus is 3.2; the digit is 4.4 times as long as broad and has 8 spines, the terminal one included.

The pereiopod V has a very slender dactylus; its length is contained hardly 3 times in the propodite. The dactylus is 5 times as long as broad and bears only 27 spines. This specimen possesses 10 uropodial spines.

The three specimens from North Yanco, Narrandera, are not well preserved, being almost all devoid of their pereiopods. In the form, the dimensions and the armature of the rostrum, they agree with this species. The rostral appendage is longer than the antennular peduncle and than the antennal scale. The formulae are as follow: $\frac{(3)\ 24}{6}$, $\frac{(3)\ 25}{6}$, $\frac{(3)\ 26}{4}$. The distal upper rostral teeth are always a little larger and further from one another than the proximal ones.

One male specimen of 22 mm. still possesses some of its legs, and when measured, fairly large differences were found between these limb measurements and those given for the before-mentioned specimens from Horton River.

The carpus of the two pairs of chelipeds is a little shorter (resp. 2.3 and 5, instead of 2.5 and 6); at the pereiopod III, the digit is in proportion with the propodite—a little larger, but the relation between its length and its breadth is the same. It has 11 spines (the terminal one included).

The pereiopods V are wanting.

The uropodial spines are 10-12 in number.

This new species, which I have the pleasure of naming after my late colleague at the Australian Museum, Sydney, Mr. A. R. McCulloch, should be placed near to *C. cognata* de Man[17] and *C. fecunda* Roux,[18] both of which inhabit New Guinea. It differs from these two species in its larger size, in its more elongated carpi I and II and in the dimensions of its eggs, which are smaller and more numerous.

The following table shows the proportions obtained by measuring the species *C. mccullochi* from Horton River, and comparing the results with those of the two related species from New Guinea.

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[17] After de Man, J. G., Zool. Jahrb. (Syst.), xxxviii, 1915, p. 402, and Tabelle B, p. 404.

[18] Roux, J., Nova Guinea, v, 1917, pp. 594-595.

TABLE C.

TABLE OF MEASUREMENTS OF

		Caridina		
		mccullochi n. sp.	*cognata* de Man	*fecunda* Roux
	Total length (female ovig.)	28.30 mm.	21-22 mm.	14-15 mm.
1st Chelip.	Carpus, length : breadth	2.5-3	1.8-2.5	2.5
	Chela, l. : br.	2.2-2.6	2-2.2	2
	Chela, dactyl. : palm	1.27-1.4	1.1-1.65	1.51
2nd Chelip.	Carpus, length : breadth	6-6.6	4.7-6	5-5.2
	Chela, l. : br.	2.6-3.2	2.6-2.9	——
	Chela, dact. : palm	1.1-1.4	1.6-1.9	1.51
III. Pereiop.	Propod. : dactyl.	3.7-4.1	3.6-4.2	3-3.5
	Dactyl. length : breadth	4-4.75	3.86-4.5	5
	Spines	9-10	5-6	7-8
V. Pereiop.	Prop. : dactyl.	3-3.1	3.1-3.6	3.7
	Dactyl. length : breadth	5.3-5.7	4.6-5.4	6.2
	Spines	56-57	30-50	40-45
Eggs	Length	0.5-0.53 mm.	0.8-1 mm.	0.8 mm.
	Breadth	0.33-0.35 ,,	0.4-0.56. ,,	0.5 . ,,

Genus ATYA *Leach.*

I wish to say here some words about the genus *Atya* and its presence on the Australian continent.

ATYA SCABRA *Leach.*

In his paper, published in 1905, Bouvier[19] mentions that there are in the Paris Museum two specimens of *Atya*, collected by Baron von Müller in the State of Victoria, and identifies these as *Atya scabra* Leach, which species is known to inhabit the islands of Central America, the western part of Africa and also New Caledonia.[20]

Thanks to the kindness of Prof. Chas. Gravier, I was able to examine these two specimens, the determination of which I consider to be correct.

If this record of *A. scabra* for Australia is correct—and it seems to me that it cannot be contested—it would indicate for this species an enormous area of geographical dispersion, just as for the other species of this genus. I must notice, however, that no other mention of *Atya* had since been made for Australia until 1923, when McCulloch and McNeill described a new species *A. striolata* (see below).

On my enquiring, the Director of the Australian Museum at Sydney wrote to the other museums in Australia to obtain information upon the eventual presence of specimens of this genus in those collections. Up to now the answers are in the negative ; there are, for instance, no specimens of *Atya* at the National Museum in Melbourne. We must therefore admit that, if the species *A. scabra* does really exist in Australia, it must be very rare.

The question of the rarity of the genus *Atya* in the Australian continent must probably be in relation with the luxurious development of the family Parastacidae, which inhabits the same waters in this big island. Nevertheless, it is not impossible that the two species *A. moluccensis* (de Haan) and *A. pilipes* Newp., which inhabit neighbouring territories, will also be found in the northern part of Australia, when our knowledge of the freshwater crustaceans of this continent is more complete.

ATYA STRIOLATA *McCulloch and McNeill.*

This species, which McCulloch and McNeill[21] described, seems to be very rare[22]—judging by the details of the occurrence given by these authors (*loc. cit.*, p. 57).

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[19] Bouvier—Bulletin scientif. France et Belgique, xxxix, 1905, pp. 122-123.

[20] Bouvier *loc. cit.*, pp. 121 and 123, identifies rightly *A. margaritacea* A. M. Edw. from New Caledonia with *A. scabra*. I have also examined these specimens (see the discussion of this question in my New Caledonian work)—*loc. cit.*, 1926, p. 217.

[21] McCulloch and McNeill—Records of the Australian Museum, xiv, 1923, p. 55, pl. ix, figs. 3-4 ; pl. x, fig. 3.

[22] The species has since been found much nearer Sydney than the type locality (Norton's Basin, Nepean River), and in quite a different watershed. There is now in the Australian Museum a good series of specimens from the upper reaches (freshwater) of the Woronora River, a stream flowing into George's River, which in turn flows into Botany Bay. The specimens were secured on the surfaces of stones in shallow water near the banks of the stream at a spot where the water was flowing rather rapidly.—EDITOR.

Thanks to the kindness of my late colleague, Mr. A. R. McCulloch, I have been able to obtain some specimens of this new and very interesting species, of which the authors have given a good description with drawings. I only wish to add a few details to their description.

The antero-lateral border of the carapace is rounded. The four anterior pairs of pereiopods possess an epipodite, the one on the fourth pair being a little shorter than the others. The uropodial spines are numerous (14-20).

The ovigerous females which are in the Museum in Sydney are 49-52.5 mm. long and the dimensions of their eggs are as follow :—length 0.4-0.425 mm., breadth 0.275 mm.[23]

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[23]Communicated by Mr. F. A. McNeill.

DESCRIPTIONS OF HELIOLITIDÆ FROM THE UPPER SILURIAN, YASS, NEW SOUTH WALES.

BASED ON NOTES BY THE LATE R. ETHERIDGE, JUNIOR.

BY

W. S. DUN,

Honorary Palaeontologist, The Australian Museum.

(Plates xviii-xxi.)

Prior to his death, Robert Etheridge, the late Director of the Australian Museum, made notes on numerous specimens and sections of specimens of the Heliolitidæ in the collections of the Australian Museum and the Mining and Geological Museum, Sydney. These notes, from a re-examination of the sections, have been amplified and, in part, form the subject of the present paper.

The interpretation of structures is based on Lindstrom's " Remarks on Heliolitidæ "[1] and as to affinities the principles adopted by Nicholson in his " Tabulate Corals "[2] have been followed.

HELIOLITES YASSENSIS, *sp. nov.*

(Pl. xviii, fig. 1.)

Corallum massive, attaining a size of about 20 cm. in diameter, height 12-15 cm. Autopores very large, circular, very even in size, 1·5-1·75 mm. in diameter, closely and very regularly spaced, outer margin plain or slightly indented, area of junction of siphonopores ·5-1 mm. Pseudosepta twelve, irregularly developed and frequently absent; when present short, straight and spine-like. Tabulæ complete, both horizontal and concave, never vesicular, spacing variable but in periods of regular growth from ·75 to 1 mm. apart; inter-tabular spaces regularly oblong. Siphonopores large and regular in form, polygonal—quadrangular to heptagonal, from ·25-·5 mm. in diameter and 1-3 in each autoporal interspace (usually two). The circum-autoporal circlet is composed of from 16 to 20 siphonopores slightly larger than the general series. The transverse structures in the siphonoporal tubes are usually regularly spaced as regards adjoining tubes, and may be transverse, concave, or even amalgamating (sub-dissepimental).

Compared with Australian Silurian types *yassensis* is distinguished by the possession of constantly large autopores with well defined margins, equal in size, relatively closely spaced, with narrow siphonoporal areas. The large size of the autopores is very distinctive, and in this respect it

[1]G. Lindstrom—K. Svenska Vet. Akad., Handlingar, 1899, xxxii.

[2]Nicholson—On the Structure and Affinities of the Tabulate Corals of the Palaeozoic Period, 1879.

compares with *H. jackii*, *H. distans*, and *H. wellingtonensis* (*vide postea*); all other types are small tubed.

The tabulæ as a rule are very regular and horizontal, though irregularity in rate of growth may lead to variations in direction, but any sign of anastomosis appears to be absent.

The siphonoporal tubes in this species is distinctive, but there is no tendency to the formation of a definite and regular autoporal circlet. The general form of the siphonoporal elements is less regular than in the species mentioned before; the transverse structures (tabulæ) are, as in the case of the autopores, very regularly horizontal. Fission in the siphonoporal tubes appears to be associated with those posesssing more than the normal pentagonal outline.

In the size of the autopore *yassensis* resembles *distans*, but the structure of the tabulæ of the siphonopores at once separates the two species; in *H. jackii*, which has similarly large autopores, the siphonopores are much larger than in *yassensis* and have curved margins; in *H. wellingtonensis*, where the autopores are equally large, the great irregularity of the siphonoporal structures is very marked.

The description is based on specimens in the Australian and Mining Museums—A.M.F. 5176, Yass, Hatton's Corner (Section A.M. 62); Mining Museum, F. 794 (Section M. 173) Hatton's Corner, Yass, T. W. E. David and M. 685, Old Limekilns Ridge, Humewood, Yass (R. Etheridge).

HELIOLITES REGULARIS, *sp. nov.*

(Pl. xviii, figs. 2-3.)

Corallum discoid, irregularly ovate, forming more or less flattened masses, upper surface convex. Autopores regularly circular, with plain margins and equal in size, ·75-1 mm. in diameter and equally spaced; the siphonopore area is from ·5-·75 mm. in extent between adjoining autopores. Pseudosepta twelve, reduced to minute spikes. Tabulæ complete and generally horizontal, occasionally concave, rarely anastomosing; spacing irregular, averaging from 3 to 4 in 1 mm. Intertabular spaces transversely oblong. Siphonopores small, averaging ·25 mm. in diameter, very regular, polygonal (mostly pentagonal), usually two in each autoporal interspace. Longitudinally the walls are usually markedly sinuous. The transverse structures (tabulæ) are usually complete and horizontal, rarely anastomosing, and occasionally highly concave.

This species falls into the *coronata* group by reason of the regularity of the structure of the circlet, in each case of 12 siphonoporal tubes, as a rule radially elongated and larger than the intermediate tubes; the autopores, however, are larger and much more widely separated in *coronata*.

The three forms *H. yassensis, jackii,* and *regularis* exhibit a very interesting gradation in the size of the autopores; *jackii* presents the

largest, *yassensis* is intermediate, and *regularis* possesses the smallest. The two last mentioned are usually associated, but are at once distinguishable from *jackii* by the remarkably curved sides of the siphonopores in the latter as compared with the angular outlines of the former two species.

The pseudosepta when present are short exsert structures and are seldom seen distinct from the exothecal thickenings, in the autoporal circlet. Amongst the Australian forms, *H. regularis* is remarkable in this respect, and would indicate an approach to *Plasmopora.*

The siphonopores are many-sided, from 8 to 14, and in such cases the width is very markedly disproportionate. Fission is noticeable in the multi-sided tubes.

Locality.—Hatton's Corner, Yass. Specimen F. 975, section M. 174. Coll. T. W. E. David.

HELIOLITES REGULARIS var. HUMEWOODENSIS, *sp. nov.*

(Pl. xviii, figs. 4-5.)

A very well marked variety of *H. regularis,* occurs at Humewood and Limestone Creek. Although it possesses the same general characters as *H. regularis,* with autopores of the same size, there is a marked difference in the size of the siphonopores, which are much smaller and more numerous in the inter-autoporal spaces. The circlet is still a distinct feature, but is not so prominent as in *regularis,* the elements being smaller and from 12-14 in number. The difference in size of the siphonopores is clearly shown in vertical sections. The pseudosepta are usually well preserved and long (about half the radius); extra-autoporal thickenings are not seen. The siphonopores occasionally become enlarged (Pl. xviii, fig. 5).

Locality.—Old Limekilns Ridge, Humewood, sections M. 585, 427; 3616. Mining and Geological Museum. Coll. R. Etheridge.

HELIOLITES JACKII, *sp. nov.*

(Pl. xviii, fig. 6 and Pl. xix, figs. 1-2.)

Corallum discoid, or irregularly ovate masses, upper surface strongly convex. Autopores circular, well defined, equally developed and widely spaced, 1·5-1·75 in diameter and 1-2 mm. apart. Pseudosepta 12, often inconspicuous and hardly developed. Tabulæ irregularly spaced, from one to three in the space of 1 mm., very directly transverse, occasionally deflected at edges, rarely incomplete. Inter-tabular spaces oblong. Siphonopores polygonal, 15-17 sided, comparatively large, variable in size. Autoporal circlet composed of tubes which are radially elongated with particularly irregular outlines, walls slightly sinuous. Tabulæ usually opposite.

The edges of the autopores are usually uneven in consequence of the form of the siphonopores of the circlet, but there is no markedly regular

pattern of successive invaginations as is evidenced in *H. porosa* Goldf.; they maintain the same dimensions and spacing very uniformly. The inter-autoporal spaces are occupied by 1-3 siphonoporal tubes. Pseudosepta are most irregular in their development, usually absent, the normal twelve being rarely shown; the thickening of the circlet cell walls corresponding to the pseudosepta has not been seen.

The autoporal circlet does not give the same uniform appearance as in the other species of this group, due to the irregularities of form and disposition of the individual calicles. It follows from this that the circlet is *H. jackii* does not show the aureole appearance of *H. coronata* and similar species. When contiguous autopores are separated by a single rank of siphonoporal tubes the latter are generally relatively much elongated.

Localities.—Hatton's Corner, Yass. Australian Museum, F. 5174 (section 57 and E. 19); F. 4801 (section 60) coll. R. A. Barbour; Hume wood F. 4498 (section 55). coll. R. Etheridge; Yarralumla, Mining and Geological Museum, F. 440 (section M. 600), Old Limekilns Ridge, Humewood; F. 2536 (section M. 611) Quedong, coll. C. Cullen; F. 455 (section 615), Hatton's Corner, coll. C. Cullen; F. 446 (section 607), Hatton's Corner, Yass, coll. C. Jenkins.

HELIOLITES DISTANS, *sp. nov.*

(Pl. xix, figs. 3-6.)

Corallum massive, larger. Autopores circular, or slightly angulate, variable in size, 1-1·75 mm. in diameter, but constantly developed in the same individual, separated by a varying width of siphonoporal tissue, from 2-6 mm. apart, margin plain or slightly sinuous. Pseudosepta often absent, when present, in the form of small incomplete blunted ridges, or nodes, corresponding with the divisions of the circlet, 12 in number. Tabulæ generally complete and horizontal, sometimes slightly oblique or concave, or slightly convex and bent downwards at outer margin; rarely incomplete and becoming vesicular; the vesicular structures, induced by anastomosis are subtriangular, three to 1 mm., four to 2 mm. or even at times 1 mm. apart. Inter-tabular spaces square or transversly oblong. Siphonopores small, about 3 mm. in diameter, very numerous, polygonal with straight sides, often becoming rounded at the angles, from two to ten between adjacent autopore tubes, average about five. Circlet not conspicuous, elements pentagonal or hexagonal, 12-15 in number, usually twelve. Transverse structures (tabulæ) very variable in position and spacing, horizontal or very oblique, slightly concave, V-shaped, infundibuliform, vesicular with triangular vesicles, opposite or alternate, from three to four in 1 mm. Fission as a rule is sparse, but when present is common.

Observations.—This is the commonest and most widely distributed species of *Heliolites* in the New South Wales Silurian and is very variable. It is distinguished from the species already mentioned by the wider spacing of the autopores and the condition of the pseudosepta, the great abundance and small size of the siphonopores, and the variable nature

of their transverse structures. A casual inspection of sections shown on Plates xxix, figs. 3-6; xx; xxi, figs. 1-4 would, from the relative sizes of the autopores and siphonopores, suggest three, or possibly four, distinct species, but the presence of intermediate forms forming gradations from one to the other and the general similarity of siphonoporal structures lead to the establishment of a series around forms of the type of Pl. xix, fig. 4, with large autopores 1·75 and sometimes nearly 2 mm. in diameter and at the other extreme that figured in Pl. xxi, fig. 3 with autopores never more than 1 mm. in diameter, yet in longitudinal section of the tabulæ practically the same, whilst in transverse section these structures present features not often seen in any of our species. Under these circumstances it would appear advisable to regard this set of forms as constituting a protean species that may be divided for convenience into fairly definite varieties by the proportions of various parts.

The autopores are largest in specimens such as F. 56 (Pl. xxi, fig. 6) and F. 603 (Pl. xix, fig. 4), which may be taken to represent the species in chief; from 1·5-1·7 mm. in diameter. The first gradation in size is seen in F. 43 (Pl. xx, fig. 4) and F. 587 (Pl. xx, fig. 2) where they vary from 1·25-1·5 mm. and this will constitute variety (a) *shearsbyi humewoodensis*. The next is based on decrease in size of autopores variety (b), *intermedia*, F. 76 (Pl. xx, fig. 6), 1-1·25 mm. in diameter; and the smallest is based on specimens F. 34 (Pl. xxi, fig. 3) and F. 34 (Pl. xxi, fig. 4) in which the diameter seldom exceeds 1 mm. This variety is named *minuta*. It will be seen that these differences in autopore dimensions are associated with other minor characters.

The structure of the autopores differs but little in the various forms, but in some the circular contour is somewhat modified by a slight angularity arising from the absence of curvature on the proximal edge of the circlet siphonopores. This is perhaps most accentuated in the species in chief (Pl. xix, fig. 6) and least so in var. *intermedia* (pl. xx, fig. 6) and var. *minuta* (Pl. xx, fig. 2); in this species the angularity of contour becomes slight flexuosity.

The siphonoporal area between the autopores presents considerable variation. In *H. distans* F. 56 and 603 there are from two to eight siphonopores between adjoining autopores, usually from five to six, covering a space of about 4 mm. In var. *humewoodensis* F. 43, 587 there are from five to ten siphonopores, occupying a space of 4-6 mm. In var. *intermedia* F. 76 there are 4-8 siphonopores covering 2-3 mm., and in var. *minuta* F. 34, 73 from five to eight siphonopores occupying from 2-3 mm. space.

Pseudosepta proper are not present in the varieties but are represented in var. *humewoodensis* occasionally, more frequently in *intermedia*, and abundantly in *minuta* by twelve inwardly directed thickenings of the autoporal wall, like small knobs, arising possibly from a thickening at the junction of the autoporal wall with the proximal ends of the circlet siphonopore walls, to which, most, if not all, the pseudoseptal structures are opposite. It is noticeable that when a thickening of autoporal wall is absent there is no trace of these structures.

The tabulæ of the autopores are variably spaced, from 1 mm. apart down to four to 1 mm., usually complete and horizontal, occasionally concave. (F. 5187 Pl. xix, fig. 5), rarely convex (Pl. xx, fig. 3 and Pl. xxi, fig. 3), or vesicular (Pl. xx, fig. 5). The inter-tabular spaces usually transversely widened, sometimes square (Pl. xxi, fig. 3).

The structure of the siphonopores throughout this group is very characteristic and separates the members at once from the other Australian *Heliolites* examined. The siphonoporal tubes are very numerous and small, regularly angular, curved sides being rare, usually pentagonal or hexagonal, rarely quadrangular or heptagonal. The size is in proportion to that of the autopores; the largest are formed in *H. distans* (Pl. xix, figs. 4 and 6). In *humewoodensis* and *intermedia*, they are smaller, whilst in *minuta* the tubes are extremely small (Pl. xxi, figs. 3-4). The rounding of the angles of the polygonal siphonopores (Pl. xxi, fig. 1) and a less extent in Pl. xxi, fig. 4, is caused by a secondary thickening, which is seen in its most exaggerated form in some parts of the corallum of specimen F. 5556 (Pl. xx, fig. 6), giving to the tubes a rounded or oval section.

The circlet in this group is not a very prominent feature; the elements are usually pentagonal, sometimes hexagonal. In var. *minuta* the number of tubes in the circlet is most constantly twelve (Pl. xxi, figs. 3 and 4); in *humewoodensis* and *intermedia* the number is 12-15.

The transverse structures (tabulæ) of the siphonopores constitute a peculiar and important feature in the *distans* group. The structures may be kept opposite, sub-opposite, or alternate in contiguous tubes, and are very variable in their spacing, horizontal (Pl. xxi, fig. 3), very oblique (Pl. xxi, fig. 4, Pl. xix, fig. 6, Pl. xx, fig. 6), or slightly concave (Pl. xxi, fig. 4), at times almost sigmoidal, often V-shaped (Pl. xix, fig. 5), infundibuliform, and here and there vesicular (Pl. xxi, fig. 2). Usually there are three to four to 1 mm. In some instances tubes are seen in which the structures are constant for some distance of whatever condition it may be (Pl. xx, fig. 3, Pl. xix, fig. 5), or a tube may possess any two or three of the modifications giving a very remarkable appearance (Pl. xix, fig. 5, Pl. xx, figs. 1 and 3) which may almost be taken as a specific character. The absence of a constant horizontal growth leads to corresponding peculiarities in transverse sections; the cut edges of oblique tabulæ show as oblique lines across the siphonopore, the V-shaped showing as arches or portions of circlets, and so on (Pl. xxi, figs. 1 and 3).

H. distans is close to *H. murchisoni* Nich. and Eth. fl, which Lindstrom classes in the *interstinctus-deciptens* group,[3] but has greater autoporal interspaces and a greater number of siphonopores, *i.e.*, a lesser number of autopores in a given area. The same comparison may be made with *H. subtubulata* McCoy.[4] It is even nearer to *H. micropora* Eichw.[5] in comparison with the well marked character of the pseudosepta. It pre-

[3]Lindstrom—Op. cit., p. 51.

[4]McCoy—Brit. Pal. Fossils, 1851, t. 2, c., f. 2-2b.

[5]Eichwald—Lethaea Rossica, 1860, p. 454, t. 25, f. 7 a-e.

sents a close resemblance to Roemer's figure of *H. interstincta* from the United States.[6]

To sum up, the species in chief, *distans*, may be distinguished by its larger autopores, 1·5-1·75 mm. in diameter, and correspondingly large siphonopores; the absence of any trace of prominent pseudosepta; the constant and marked lack of horizontalities in the siphonoporal tabulæ and their frequently marked V-shape; circlet elements from 12-16.

Localities.—Austr. Mus. F. 5173 (Sec. A.M. 56) Yass.

Austr. Mus. F. 4082 (Sec. A.M. 140) Old Limekilns Ridge. Coll. R. Barbour.

Mining and Geol. Mus. F. 1828 (Sec. 603) Yass. Coll. T. W. E. David.

" " " F. 3616 (Sec. 588) Old Limekilns Ridge, Humewood. Coll. R. Etheridge.

Mining and Geol. Mus. F. 3616 (Sec. 586) Old Limekilns Ridge, Humewood. Coll. R. Etheridge.

HELIOLITES DISTANS, var. HUMEWOODENSIS, *var. nov.*

(Pl. xx, figs. 3-4.)

Varietal characters.—Autopores 1·25-1·5 mm. in diameter, siphonoporal structures very similar to those of *distans*; the circlet enlarged, 12-16 tubes.

Localities.—Austral. Mus. F. 4082 (Sec. A.M. 43) Old Limekilns Ridge, Humewood. Coll. R. A. Barbour.

" F. 5548 (Sec. A.M. 72) Old Limekilns Ridge, Humewood. Coll. R. A. Barbour.

Mining Geol. Mus. F. 3616 (Sec. A.M. 601) Humewood, Old Limekilns Ridge, Yass. Coll. R. Etheridge.

Austr. Mus. F. 5547 (Sec. A.M. 71) Humewood, Old Limekilns Ridge, Yass. Coll. R. Etheridge.

Min. Geol. Mus. F. 3616 (Sec. 587) Humewood, Old Limekilns Ridge, Yass. Coll. R. Etheridge.

" " F. 3616 (Sec. 599) Humewood, Old Limekilns Ridge, Yass. Coll. R. Etheridge.

HELIOLITES DISTANS, var. INTERMEDIA, *var. nov.*

(Pl. xx, figs. 5-6.)

Varietal characters.—Autopores 1-1·25 mm. in diameter, siphonopores as in *distans*. In this variety the pseudoseptal projections are more freely developed and the circlet is constantly composed of twelve elements, and siphonoporal tabulæ are very vesicular.

[6] Roemer—Sil. Fauna West Tennessee, 1860, t. 2, f. 5, 5 a.

Localities.—Austr. Mus. F. 5555 (Sec. A.M. 75) Old Limekilns Ridge Humewood. Coll. S. R. Mort.
„ F. 5556 (Sec. A.M. 76) Old Limekilns Ridge, Humewood. Coll. S. R. Mort.
„ F. 2433 (Sec. A.M. 52) Old Limekilns Ridge, Humewood. Coll. S. R. Mort.
Min. Geol. Mus. F. 3616 (Sec. M. 610) Old Limekilns Ridge, Humewood. Coll. R. Etheridge.
„ „ F. 2397 (Sec. M. 602) Bowning. Coll. T. Ranft.

HELIOLITES DISTANS, var. MINUTA, *var. nov.*
(Pl. xxi, figs. 1-4.)

Varietal characters.—Autopores small, never more than 1 mm. in diameter, siphonopores much reduced in size. Pseudoseptal structures nodose and highly developed, circlet constantly of twelve siphonopores.

Localities.—Austr. Mus. (Sec. E. 34) Yass District, Hatton's Corner. Coll. R. L. Jack.
„ F. 2461 (Sec. A.M. 53) Bowning. Coll. R. L. Jack.
„ F. 5554 (Sec. A.M. 74) Old Limekilns Ridge, Humewood.
„ F. 5553 (Sec. A.M. 73) Old Limekilns Ridge, Humewood.

Plasmopora, M. Edw. and Haime, 1849.

(*Compt. Rendus*, xxix, p. 262; Emend. Lindstrom, *K. Sv. Vet. Akad.*, *Handl.*, 1899, xxxii, p. 74.)

PLASMOPORA SHEARSBYI, *sp. nov.*
(Pl. xxi, figs. 5-6.)

Corallum massive, corallites long, slightly flexuous. Autopores oval to circular, closely spaced, 1·25-2·75 mm. in diameter, margins plain or very slightly flexuous, from ·25-·5-1 mm. apart; the last spacing is unusual. Pseudosepta absent. Exothecal thickenings ("spines") short, inconspicuous, and irregular; when present the autopore margin is somewhat thickened. Tabulæ complete, close, very slightly concave, 3-5 in 1 mm. space. Siphonoporal area composed of very irregularly shaped vesicles, one to three series between autopores; the vesicles are lenticular and very irregular. Siphonoporal walls are absent. Exothecal spines sometimes coincide with cut edges of the siphonoporal vesicles but usually project into the spaces. The siphonopores are irregular both in shape and disposition. In section the cut edges are usually faint in comparison with the thickened autopore walls.

Localities.—Austr. Mus. (Sec. E. 21) Yass. Coll. R. L. Jack.
Min. Geol. Mus. F. 976 (Sec. 175) Hatton's Corner, Yass.
„ „ F. 3734 (Sec. M. 291) Bungonia. Coll. W. Guymer.
„ „ (Sec. M. 243), F. 3805, Hatton's Corner.

SOME NEW AUSTRALIAN NYCTERIBIIDÆ (DIPTERA PUPIPARA).

By

A. Musgrave, F.E.S.,
Entomologist, the Australian Museum.

(Plates xxii-xxiii.)

In a recent paper[1] I listed five species of Nycteribiidæ for Australia. In my present contribution I propose to describe five Australian forms which appear to be new, and give a few notes on known species. Some of these Nycteribiids have been secured by members of the staff of the Australian Museum, while others have been kindly loaned by the Directors of other Australian museums. I am indebted to my colleague Mr. E. Le G. Troughton for identifying for me the bats from which parasites were taken. The insects loaned by kindred institutions are unfortunately without the scientific names of their hosts, the word "bat" with which they are labelled, being valueless to describe as host an animal upon which all Nycteribiids occur. Some of these specimens too, were mounted on card, an unsatisfactory method, while others were mounted in Canada balsam and insufficiently cleared. Nycteribiids should be preserved in 70 per cent. alcohol, though much of the material upon which this paper is based has been cleared and mounted in Canada balsam. I would also acknowledge my indebtedness to Miss Joyce K. Allan for the care taken, and great assistance afforded, in the preparation of the illustrations.

Genus Nycteribia *Latreille* 1796.
Subgenus Nycteribia *Latreille* 1796.

The species I propose to describe as new are members of the genus *Nycteribia* s. str. and are all similar in general characteristics to *N. falcozi* Musgrave, and *N. brevicauda* Musgrave, the males differing chiefly in size and in the presence or absence of bristles on the discs of the tergites and sternites, while the females, too, resemble one another in possessing a second tergite subchordate in form and with the posterior margin produced into two acuminate processes bearing bristles which vary in size and number in the different species.

The curious shape of the second tergite of the females has its parallel in the abdomens of the females of *Penicillidia fletcheri* Scott, *P. bathybothyra* Speiser (*P. pumila* Scott), *P. peali* Scott, and in *Tripselia amiculata* Speiser (*Nycteribia* (*Achrocholidia*) *fryeri* Scott). Through the courtesy of Dr. Scott I have been able to examine a male and female of *Tripselia amiculata*, and though our Australian forms approximate very closely to them they are at once differentiated by the tibial rings

[1] Musgrave—*Rec. Austr. Mus.*, xiv, 4, 1925, pp. 289-300, pls. xliv-xlv.

and the slender legs. The tibial rings are wholly absent in the species I have described and those which I regard as new, but on the under surface of the tibia may frequently be seen light areas apparently homologous with those on the tibia of *Tripselia* but which, nevertheless, do not encircle the tibia.

Scott has stated,[2] " I have received through Dr. Bequaert 1 ♂ and 1 ♀ from Sumatra, belonging to a form which closely resembles *T. fryeri* except in the following particulars : size smaller, legs noticeably shorter, especially femora, and both femora and tibiae stouter ; ventral hind margin of thorax in both sexes fringed with long bristles (absent in typical *fryeri*), three on each side of the middle line, with shorter ones between them. Detailed consideration of this form, stated to be from *Pipistrellus sp.* must be deferred." As Dr. Scott has lent me this material from Tarussan Bay, Sumatra, I have been able to compare the male and female with those species I propose to describe, as well as with the male and female of *Tripselia amiculata*. In a letter to me, Dr. Scott writes, " The *Tripselia sp.?* from Sumatra may not be a true *Tripselia* at all. It may be a *Nycteribia* allied to your *N. falcozi*."

My examination of the two species confirms his first statement, and the Sumatran species may therefore be definitely associated with the Australian species of the subgenus *Nycteribia*. I hesitate, however, in deciding whether the Sumatran species may be referrable to *N. falcozi* or not. It is smaller than the typical specimens of *falcozi*, and differs in minor structural details, though it is very similar in form and structure to some Nycteribiids I have placed below under *falcozi*.

The Australian forms of *Nycteribia* s. str. are quite unlike the European and Asiatic forms, except for the absence of the eyes and the somewhat similar shape of the limbs, the abdominal segmentation being on a very different plan. Our species at first glance would seem to have closer affinities with the genus *Tripselia*, except for the reasons stated by Scott in his remarks on the Sumatran insect.

Key to the Australian species of the genus *Nycteribia* s. str.

Females.

A. Small species of 1·5 mm. in length...*halei* n. sp.

AA. Larger species exceeding 1·5 mm. in length.

B. Species with lobes beneath the acuminate processes of tergite 2.

C. Lobes rounded and bearing many spines.......................*troughtoni* n. sp.

CC. Lobes pointed and bearing few spines..........................*burrelli* n. sp.

BB. Species without lobes beneath the acuminate processes.

D. Long bristles on the posterior margin of basal tergite half the length of those on the acuminate processes of tergite 2.........*brevicauda* Musgrave

DD. Long bristles on the posterior margin of basal tergite considerably more than half the length of, or as long as those on the acuminate processes of tergite 2.

E. Disc of tergite 2 densely clothed with minute bristles...*multispinosa* n. sp.

EE. Disc of tergite 2 sparsely clothed with minute bristles.

F. Long bristles on posterior margin of basal tergite more than half the length of tergite 2....................................*longispinosa* n. sp.

[2]Scott—Parasitology, ix, 4, 1917, p.608.

FF. Long bristles on the posterior margin of basal tergite less than half the length of tergite 2................................*falcozi* Musgrave

As the males do not present differentiating characters of any value they are not included in the key.

Nycteribia falcozi *Musgrave.*

(?) *Nycteribia* (*Acrocholidia*) *oceanica* Speiser (not Bigot) Arch. Naturg., lxvii, 1, 1901, p. 41.

Nycteribia (*Nycteribia*) *falcozi* Musgrave, Rec. Austr. Mus., xiv, 4, 1925, p. 292, pl. xliv, and pl. xlv, figs. 5-7.

Hab.—Queensland: Cunnamulla, 9 males and 8 females mounted in Canada balsam, and others on card, collected by Mr. H. Hardcastle on a bat.

New South Wales: Wagga, 25.1.1925, 1 ♀ collected by Mr. H. V. Brann from a bat.

Tasmania: near Bicheno, East Coast, 4 ♂ 3 ♀, on *Eptesicus pumilis* Gray, collected by Professor T. T. Flynn of the University of Tasmania.

Note.—I refer all the above specimens to this species as I cannot find characters to separate them from this form. They differ however from the typical *falcozi*, in that they are smaller and the limbs proportionally shorter. The males of the Cunnamulla specimens measure from 1.8 to 2.1 mm. in length, and the females from 1.7 to 2.3 mm. The males of the specimens from near Bicheno measure from 1.7 to 2 mm., and the females from 1.6 to 1.7 mm.

Nycteribia troughtoni, *sp. nov.*[3]
(Pl. xxii, figs. 1-4.)

Length.—♂ 2·1-2·3 mm., ♀ 2-2·3 mm.

Colour.—Yellow-brown. Specimens mounted in Canada balsam yellowish.

Head bare, except for a few moderately long bristles on the vertex and a few short ones on the anterior margins of the cheeks directed forwards.

Thorax beneath nearly a third broader than long, almost flat, the surface covered with minute bristles. The median longitudinal furrow broadened behind the middle and terminating in a depression. Hind margin bearing a fringe of six long bristles, three on each side of the middle line, and towards the lateral angles, while along the middle and interspersed with these are smaller bristles. On the dorsal surface, the bristles in front of the halteres pits vary in number; thus in the specimens examined by me the bristle formula reads as follows.—

Register No.	Left Side	Right Side	Sex
K. 51801 ...	... 12	11	♀
K. 51802 ...	... 13	13	♀

[3]Named in honour of my friend Mr. E. Le G. Troughton, Mammalogist, Australian Museum.

Legs.—Front coxæ twice as long as broad, provided with short stout bristles towards the anterior margin, those on the posterior margin being longer and few in number.

The femora bear numerous short bristles on their anterior surfaces and are much more closely bespined than in *Nycteribia falcozi*. The posterior dorsal portions are bare, as are also the ventral posterior surfaces.

The femora are nearly three times as long as broad and are much broader than in *falcozi* or *brevicauda*.

♀ *Abdomen* (Dorsal aspect) (Pl. xxii, fig. 1). *Basal tergite* small and not reaching to the sides of the abdomen, its posterior margin widely sinuate and bearing at the posterior angles 6-7 large bristles of equal length. At the sides of the disc are some short, dark, bristles, while the middle is bare. *Tergite* 2 long and broad, subchordate in form and divided longitudinally into two halves by a faint irregular line. Each side is somewhat convexly curved anteriorly and concavely sinuate posteriorly, the posterior margin being produced into two acuminate processes. Each acuminate process bears 4-5 long, dark, stout bristles and 4-5 short, dark thorn-bristles. The disc is bare for the most part, but towards the centre of the tergite and on either side of the dividing line occurs a group of scattered short bristles and other groups exist at each anterior angle. A few bristles are present near the lateral margins of the abdomen. Beneath the produced posterior margin, and connected on either side with the connexival membrane, is a pair of rounded lobes carrying on their apices an outer row of 4-5 long stout spines, and an inner row of 1-3 shorter ones. These bristles may vary in size and number in the same specimen. *Anal segment* broader than long, its surface bare. Anteriorly each side is convexly curved, while the hind margin is emarginate. From each posterior angle spring two long stout dark bristles and a group of thorn bristles.

(Ventral aspect) (Pl. xxii, fig. 4). *Basal sternite* twice as broad as long, the middle line furrowed, the surface with 5 irregular rows of short bristles. Ctenidium with 68 spines. *Sternites* 2 and 3 are very short, and in the middle are covered by the spines of the ctenidium, the ends of the bristles projecting beyond the ends of the spines. The bristles of these sternites are longer at the sides than towards the centres of the margins. *Sternite* 4 short, its surface bare, the bristles on the hind margin resembling those of the preceding sternites but spaced farther apart. *Sternite* 5 much longer, and with a row of bristles on the hind margin resembling those of the other sternites and with 2-3 long bristles at the sides. In front of the hind margin occur one or two rows of small bristles. *Subgenital plate* broad, membranous, bare, with a row of short bristles on the posterior end of the disc. Between this row and the margin, at each posterior angle, are situated 2 moderately long suberect bristles. On the rounded hind margin is a group of 14 bristles, consisting of 8 short bristles situated in the middle; on either side of which are 2 pairs of longer ones, while at the outer sides of these again is a single short bristle.

♂ *Abdomen* (Dorsal aspect) (Pl. xxii, fig. 2). *Basal tergite* small, trapezoidal, and bearing a number of small bristles. The tergite is almost

entirely hidden by the flexing of the next tergite, and the suture is not clearly defined. *Tergite* 2 bearing one or two rows of minute bristles near the anterior margin and a group of bristles at each anterior angle. The long bristles on posterior margin extend to the border of the next tergite, and alternating with each pair of bristles are one or two minute bristles. *Tergite* 3 bare, the long bristles on the posterior margin extend only a little more than half way on to the next tergite, owing to the flexure of the abdomen. Minute bristles alternate with the long ones. *Tergites* 4-5 bare, bristles on posterior margin shorter in the middle, those at the sides extend as far as, or beyond, the border of the next tergite. The small bristles which alternate with the long ones are much longer than the corresponding bristles of the preceding tergites. *Tergite* 6 bare on the disc. On the posterior margin the long hairs are less numerous than in the other tergites, though some are extremely long and extend more than half the length of the anal segment. *Anal segment* moderately short, bare towards the anterior margin, covered with evenly spaced bristles towards the posterior margin and with two long erect bristles in the apical third. At the lateral margins are erect bristles while 2 long and 2-3 short bristles occur on each posterior angle.

(Ventral aspect) (Pl. xxii, fig. 3). *Basal sternite* with middle line slightly furrowed, the surface with irregular rows of short bristles and a group of bristles near each anterior lateral margin. Ctenidium with 50-60 spines; 54 in allotype. *Sternites* 2 and 3 have their posterior margins beset with long bristles, varying somewhat in length, those at the sides being much longer than those in the middle. The discs bare, except for a few bristles towards the lateral margins. *Sternite* 4 slightly longer than the two preceding sternites. Posterior margin curved, and bearing in the middle short, stout, thorn-bristles arranged in two rows, one on the margin of 12, the other in front of 13 bristles, though these numbers are subject to variation. Other bristles of different lengths alternate with the thorn-bristles and extend on either side, those towards the lateral margins being much longer than the others. A row of bristles occurs in front of the marginal series. *Anal segment* with a number of erect hairs at the sides. Claspers strong, reaching almost to the anterior margins, their apices directed downwards. On their outer sides are short slender bristles directed outwards, and towards the base are a series of short bristles, their apices directed inwards, and a pair of long erect bristles.

Hab.—New South Wales: Glenroy, Hartley, April, 1923, 2 ♀, on *Chalinolobus gouldi* Gray, collected by Mr. Robert Stein; Smithfield, 27th May, 1925, 2 ♀, on *Chalinolobus gouldi* Gray, collected by Mr. R. Stein; Munni, Williams River, 27th July, 1921, 1 ♂ on *Chalinolobus gouldi* Gray, collected by Mr. N. Cayley. South Australia: Lucindale, 3♂ 6 ♀, collected by Mr. F. Secker from an undetermined host.

Types.—Holotype ♀ K 51801, and paratype ♂ and females in the collection of the Australian Museum. Allotype ♂ and paratype male and females in the collection of the S.A. Museum.

Material examined.—The nine specimens from Lucindale, South Australia, forwarded on loan from the South Australian Museum, were mounted on card, and of these two males and a female are badly damaged.

Three females and two males have been cleared and mounted in Canada balsam. I have regarded the males as belonging to the same species as the females, as the card upon which they were mounted says " on bat." A single male collected at Munni, Williams River, N. S. Wales, from the same species of bat as that on which the holotype was secured, appears to be identical with the males from Lucindale, S. Australia. I have therefore associated it with this species. The material collected by Mr. Stein has been cleared and mounted in Canada balsam, with the exception of one female from Smithfield, New South Wales, preserved in alcohol. The holotype ♀ is from Glenroy, Hartley, New South Wales.

Note.—The female is a stout, thick-set insect with the thorax as broad as half the total length. It may be recognised in cleared specimens by the rounded lobes bearing spines, which are situated beneath the produced posterior margin of tergite 2, but in specimens preserved in alcohol, these lobes are hidden and only the ends of the bristles may be seen projecting from the sides. The male has the discs of the tergites devoid of minute bristles.

NYCTERIBIA MULTISPINOSA, *sp. nov.*
(Pl. xxii, figs. 5-10.)

Length ♂ 2·9-3 mm., ♀ 2·6-2·9 mm.

Colour yellow-brown, specimens in Canada balsam yellowish.

Head bare, except for a few bristles on the vertex.

Thorax beneath broader than long. The hind margin bears 8 long bristles, the median pair being shorter than the others and these are interspersed with smaller bristles. On the dorsal surface, the bristles in front of the halteres pits vary in number from 14-18 in different specimens.

Legs.—Front coxæ 1¾ times as long as broad, provided with short, stout bristles towards the anterior margin, those on the posterior margin being longer. Front pair of femora bearing numerous short bristles on their anterior surfaces, while the posterior dorsal and ventral surfaces are devoid of them; middle pair with anterior and posterior dorsal surfaces densely covered with bristles, the posterior ventral surfaces bare. Otherwise the legs conform to those of *troughtoni*, *falcozi*, and other Australian species of the genus.

♀ *Abdomen* (Dorsal aspect) (Pl. xxii, fig. 5) *Basal tergite* small, trapezoidal, and not reaching to the sides of the abdomen, the hind margin widely sinuate and bearing on either side of the groove a row of 7-8 long, and 3-5 small bristles. The bristles of this row may vary in number on either side of the sinuation. At the sides of the disc are short, dark bristles, while the middle is bare. *Tergite* 2 long, moderately broad, subchordate in form, and divided longitudinally by a faint median line. Anteriorly each side is slightly convex while posteriorly it is concavely sinuate, the posterior margin being produced into two acuminate processes. (In females in which the abdomen is distended these curves are more accentuated.) Each acuminate process bears a row of long bristles which may vary in number on the two processes in the same specimen. (In the holotype there are seven on each process.) In front of the long

bristles are two rows of small thorn-bristles, consisting of 7-8 in each row, while the area in front of this again is bare, or one or two thorn-bristles may be present on the lateral concavity. On either side of the median dividing line, a number of short dark bristles extend from the inner side of the posterior margin towards the basal tergite, and these in conjunction with the light-coloured connexival membrane along the dividing line, give the insect the appearance of having a definite parting in the hair. This whitish furrow is particularly noticeable in specimens preserved in alcohol. The rest of the tergite is covered with irregular transverse rows of similar short bristles, with a group at each anterior angle, as well as a series of 7-8 moderately long bristles on the lateral margins.

Beneath the produced posterior margin is a row of 2-4 moderately long bristles. *Anal segment* short and tapering slightly, its surface bare; at the sides and anterior lateral angles are a number of bristles. Posterior margin emarginate, from the posterior angles are given off two long bristles, while smaller ones occur along the posterior margin, and moderately long ones along the lateral margins.

(Ventral aspect) (Pl. xxii, fig. 6). *Basal sternite* slightly furrowed, the surface with seven irregular rows of short bristles. Ctenidium with 56-66 spines. *Sternite* 2 short, and with a row of bristles on the hind margin covered; medially by the ctenidium. (In females in which the abdomen is distended the sternite is equal in length to the two succeeding sternites, and may bear six irregular transverse rows of small bristles.) *Sternite* 3 short, its surface bare, the row of bristles on posterior margin resembling those of preceding sternite. *Sternite* 4 similar to preceding but longer and bearing long hairs at the sides. A row of short bristles is present in front of these and is situated towards each lateral margin. (In gravid females these bristles extend more towards the middle line.) *Sternite* 5 longer, equal to the two preceding sternites together, with a series of long bristles on the hind margin interrupted medially, and carrying in front towards the lateral margins two irregular rows of bristles. *Subgenital plate* broad, bare, carrying on its posterior end on the disc an irregular row of bristles interrupted medially. Two short and 2-3 long bristles occur between this row and the hind margin. Posterior margin rounded with a row of about 14 long bristles and some shorter ones towards the sides.

♂ *Abdomen* (Dorsal aspect) (Pl. xxii, fig. 7). *Basal tergite* small, trapezoidal and almost hidden by the arching of the next tergite. *Tergite* 2 covered with irregular rows of tiny black bristles, the hind margin bearing a row of long bristles some of which extend to the border of the following tergite. *Tergite* 3 covered with rows of tiny bristles and bearing on the posterior margin rows of long bristles interspersed with shorter ones, the long ones extending more than half way on to the next tergite. *Tergite* 4 with irregular rows of small bristles, which increase in length as they near the posterior margin, and leave a bare area towards each lateral margin. On the posterior margin the long bristles are interspersed with smaller ones, the longer bristles extending as far as the border of the next tergite. *Tergite* 5 provided with rows of bristles similar to those of the last tregite, but the rows are shorter and leave a larger portion of the

sides bare. On the posterior margin the long bristles, which are interspersed with shorter ones, extend well past the border of the next tergite. *Tergite* 6 bare. On the posterior margin the longer bristles are less numerous and the centre is occupied by shorter ones, but two of the long bristles extend almost the full length of the anal segment. *Anal segment* long, bare towards anterior margin, otherwise covered with short bristles fairly evenly spaced and with two moderately long erect bristles in the apical third. At the sides are erect bristles, and from each posterior angle springs two long and 3-4 short bristles.

(Ventral aspect) (Pl. xxii, fig. 10). *Basal sternite* with middle line furrowed. Surface with irregular rows of small bristles and a group of bristles near each anterior lateral margin. Ctenidium with 60 spines. *Sternite* 2 covered for the most part by the spines of the ctenidium, but with two rows of tiny bristles on the disc and a row of long bristles extending beyond the border of the next sternite. A group of bristles is present at each posterior lateral margin. *Sternite* 3 bare but for a few tiny bristles near the posterior margin. The bristles on the posterior margin are short towards the middle but increase in length towards the sides and extend beyond the border of the next sternite. *Sternite* 4 longer than the two preceding sternites. Posterior margin curved, and bearing in the middle short, dark thorn-bristles arranged in two rows, one on the margin of 13, the other in front of 10, bristles. Other bristles of varying length occur on either side of these and in front of the marginal series is a row of long semi-erect bristles. *Anal segment* with a number of erect bristles at the sides. Claspers strong and reaching to the anterior margin, provided with the usual series of short and long bristles on the base and sides.

Hab.—New South Wales: Berrima, 3,000 ft., 3 ♂, 7 ♀, on *Scoteinus rüppellii* Peters, collected by Mr. T. V. Sherrin; Barrington River, 4,800 ft., January 26th, 1925, 1 ♂, on *Scoteinus rüppellii* Peters, collected by Mr. T. G. Campbell.

Types.—In the collection of the Australian Museum, holotype ♀, register number K 55122, allotype ♂ register number K 55129, and paratypes.

Material examined.—Three females, one the holotype, and one male of the Berrima series have been cleared and mounted in Canada balsam, and also the male from the Barrington River which appears to belong to this species. The remainder of the material is preserved in alcohol. The abdomen of the holotype female is not distended, but the other females all appear to have distended abdomens.

Note.—The most outstanding character of the female is the dense pubescence on the disc of tergite 2, which, in most specimens preserved in alcohol, has a distinct longitudinal parting through the centre of the tergite due to the whitish connexival membrane on either side of the dividing line showing through. This is particularly noticeable in females in which the abdomen is distended (Pl. xxii, figs. 8, 9, the illustration prepared from a paratype preserved in alcohol). In one specimen, register number K 55127, the minute bristles extend on to the dividing line.

NYCTERIBIA HALEI, *sp. nov.*[4]
(Pl. xxiii, figs. 1-3 and 6.)

Length ♂ 1·6 mm., ♀ 1·5 mm.

Colour.—Specimens mounted in Canada balsam, light-yellowish.

Head bare, a few bristles on the vertex.

Thorax beneath nearly as long as broad, otherwise resembling that of *falcozi*, the bristles on the posterior margin consisting of 6 long bristles interspersed with shorter ones. The bristles in front of the halteres pits on the dorsal surface, number 10-11 on each side.

Legs.—Front coxæ more than twice as long as wide, otherwise nothing noteworthy.

♀ *Abdomen* (Dorsal aspect) (Pl. xxiii, fig. 1). *Dorsal tergite* trapezoidal, the lateral margins darkly-pigmented,the posterior margin sinuate and bearing on either side of the groove 4-5 long bristles and several shorter ones. The disc is bare, but a few bristles are present at the anterior angles. *Tergite* 2, long, subchordate, and divided by a faint median line. Each half is convexly rounded anteriorly and concavely sinuate posteriorly, the posterior margin being acuminately produced. Each acuminate process bears 2 long and 3-4 short spines. On each side of the dividing line are one or two short dark bristles, and a few are situated at the anterior angles, otherwise the disc is bare. Beneath the posterior margin is a series of 3-4 spines, their apices directed outwards. On each side of the tergite on the lateral margins is a series of bristles three in number. *Anal segment* bare, with a few bristles at the lateral margins and posterior angles.

(Ventral aspect) (Pl. xxiii, fig. 6.) *Basal sternite* with 4 irregular rows of bristles. Ctenidium with approximately 60 spines. *Sternite* 2 bearing several transverse rows of small bristles on the disc, and a row of long bristles on the posterior margin. *Sternites* 3 and 4 bare on the disc, the posterior margin indicated by a row of long spines. The connexival membrane is here indented at the sides. *Sternite* 5 bare on the disc, but there is a transverse row of fine bristles in front of the long bristles on the posterior border. *Subgenital plate* broad, membranous, bare; a series of bristles occurs on the posterior end and at the lateral margins.

♂ *Abdomen* (Dorsal aspect) (Pl. xxiii, fig. 3). *Basal tergite* hidden by the arching of the next tergite. *Tergite* 2 with a few scattered minute bristles on the disc and at the sides, while the long bristles on the posterior margin are interspersed with minute bristles. *Tergite* 3 with a few minute bristles on the centre of the disc and long and minute intercalary bristles on the posterior margin. *Tergites* 4 and 5 are similar in appearance, being bare on the disc and with long and minute intercalary bristles on the posterior border. *Tergite* 6 similar to preceding, but the median of the long bristles extend well down the anal segment. *Anal segment* long and tapering, bare on anterior half, but with erect bristles on posterior half and lateral margins. Posterior angles each with the usual 2 long and 3 short bristles.

(Ventral aspect) (Pl. xxiii, fig. 2.) *Basal sternite* with three irregular rows of minute bristles on the posterior part of the disc, anterior portion

[4]Named in honour of the collector, Mr. H. M. Hale.

bare. A group of bristles is present on each anterior lateral angle. Ctenidium with approximately 60 spines. *Sternite* 2 bare on the disc, except for a few minute bristles. On the posterior margin the bristles are of varying length. *Sternite* 3 longer than the preceding sternite, bare on the disc, and with bristles of varying length on posterior margin, those towards the sides being the longest. *Sternite* 4 equal in length to the two preceding sternites, bare on the disc, the posterior margin convexly curved and bearing medially two transverse rows of small black thorn-bristles, one lying on the margin the other slightly in front of it. In each row are eight bristles. In front of the thorn-bristles is a row of fine bristles extending the length of the sternite, while bristles of varying length occur on either side of the thorn-bristles. *Anal segment* with a number of erect bristles at the sides and the anterior lateral angles. Claspers strong, their apices apparently not reaching the anterior margin; a long bristle springs from the base of each clasper.

Host.—*Chalinolobus morio* Gray.

Hab.—South Australia: Cave at Arkaba, 2,000 ft., September, 1924, 2 ♀ 1 ♂, collected by Mr. H. M. Hale.

Types.—Holotype ♀, register number K 51821, allotype ♂, register number K 51819, and paratype ♀ in collection of Australian Museum.

Note.—This is the smallest example of the subgenus I have seen.

NYCTERIBIA BURRELLI, *sp. nov.*[5]
(Pl. xxiii, figs. 4, 5, 9, 12.)

Length ♂ 2·1 mm., ♀ 2·3 mm.

Colour.—Specimens mounted in Canada balsam light-yellowish. Male abdomen more darkly pigmented than that of female.

Head bare, except for a few hairs on the vertex.

Thorax beneath, broader than long, the surface covered with minute bristles, otherwise the thorax is similar to that of other species of the genus. The bristles on the dorsal surface infront of each halteres pit are approximately 12 in number.

Legs.—Front coxæ twice as long as wide, otherwise there appears to be nothing noteworthy about them.

♀ *Abdomen.*—(Dorsal aspect) (Pl. xxiii, fig. 9.) *Basal tergite* trapezoidal, small, its posterior margin widely sinuate, and bearing on either side of the sinuation two moderately long black spines and some small bristles. The long bristles are proportionately much shorter than the corresponding bristles of any species I have seen. *Tergite* 2 long, subchordate, and divided longitudinally by a faint median line. Each side is convexly curved anteriorly, and concavely sinuate posteriorly, the posterior margin of the tergite being produced into two acuminate processes. Upon each acuminate process are borne two long, stout bristles and six small thorn-bristles. On either side of the dividing line are a number of minute bristles, which produce an effect similar to that of tergite 2 of *multispinosa*, viz., that of a parting down the centre of the tergite. On the anterior angles are some fine bristles, while the usual

[5]Named in honour of the collector, Mr. H. Burrell.

series of moderately long bristles occurs on the lateral margins towards the posterior end, and vary in number from 6-8. Beneath the acuminate processes, and anterior to the anal segment, are two slender pointed tubercles projecting laterally, each of which bears at its distal extremity two black thorn-bristles, while a third bristle may be present on the tubercle anteriorly. *Anal segment* short, broad, its surface bare. The posterior margin is emarginate, and from each posterior angle is given off 4 long and some smaller bristles, while two small bristles may occur on the lateral margins.

(Ventral aspect) (Pl. xxiii, fig. 12.) *Basal sternite* with middle line slightly furrowed, and the surface with about seven irregular transverse rows of short bristles. Ctenidium with approximately 64 spines. *Sternites* 2, 3 and 4 short, and bearing on their posterior margins a row of bristles. *Sternite* 2 is almost entirely hidden by the spines of the ctenidium, owing to the twisting of the abdomen. *Sternite* 5 longer than the three preceding sternites. The posterior margin bears a row of bristles resembling those of the other sternites, but spaced further apart, while a second row of fine bristles is situated on the disc in front of the marginal series. *Subgenital plate* broad, membranous bare. On the disc towards the posterior margin, is an irregular transverse row of bristles, while several sub-erect bristles occur between the row and the margin. On the posterior margin itself is a row of 13 bristles, those in the middle being short and arranged in a group of six, while a pair of long bristles occur on either side of these, and shorter ones on the outer sides of these again. Two long bristles, and some short ones are present on the lateral margins.

♂ *Abdomen.*—(Dorsal aspect) (Pl. xxiii, fig. 5). *Basal tergite* hidden by the arching of the next tergite. *Tergite* 2 bears on the posterior margin a row of long bristles interspersed with one or two minute bristles. A row of minute bristles occurs in front of the marginal row, and a few bristles at the anterior angles, otherwise the disc is bare. *Tergite* 3 with a posterior marginal series similar to the preceding tergite, and a central transverse row of minute bristles, otherwise bare. *Tergite* 4 bare. The long bristles on the posterior margin are interspersed with small bristles which are longer than the corresponding ones of the preceding tergites. *Tergite* 5 similar to preceding, but some of the long bristles are much longer than any of the previous tergites, and extend well down on to the anal segment. *Tergite* 6 bare on the disc. The long bristles are fewer in number, and the intercalary bristles are darker and more in evidence. The median long bristles are extremely long and appear to be equal in length to the anal segment. *Anal segment* bare on the disc anteriorly, but posteriorly covered with short erect bristles, while the usual two long and three small bristles occur at each posterior angle.

(Ventral aspect) (Pl. xxiii, fig. 4.) *Basal sternite* with middle line slightly furrowed, the surface with irregular rows of minute bristles. Ctenidium with approximately 60 spines. *Sternite* 2 hidden almost entirely by the spines of the ctenidium, only the ends of the long bristles borne on the posterior margin being visible. *Sternite* 3 with a posterior marginal series of long bristles, in front of which is a transverse row of minute bristles; otherwise the disc is bare. *Sternite* 4 longer than the two preced-

ing together. Posterior margin curved, and bearing in the middle stout thorn-bristles arranged in two rows, one on the margin of 11, the other in front, of about 8. On either side of these extend bristles, and in front of the thorn-bristles is the usual row of fine bristles. *Anal segment* appears to present little of noteworthy value. The claspers would appear to reach to the anterior margin, and there is the usual row of lateral bristles, and the bristles of the claspers are similar to those of other species.

Host.—*Chalinolobus morio* Gray.

Hab.—New South Wales: Caermarthen, Manilla, November, 1923, 1 ♂ 1 ♀, collected by Mr. H. Burrell.

Types.—The holotype ♀ register number, K 51823, and the allotype ♂ register number, K 51822, are in the Australian Museum.

Note.—The female of this species presents characters which readily separate it from any other known species of the genus Nycteribia, viz., the relatively shorter spines on the basal tergite, and the two slender tubercles beneath the produced posterior margin of tergite 2. The male like others of the genus appears to be devoid of distinguishing characters.

NYCTERIBIA LONGISPINOSA, *sp. nov.*
(Pl. xxiii, figs. 7, 8, 10, 11.)

Length ♂ 2·7 mm., ♀ 2·3-2·4 mm.

Colour of specimens mounted in Canada balsam yellowish, the chitin in places darkly pigmented.

Head bare, except for a few moderately long bristles on the vertex.

Thorax broader than long, almost flat, the surface covered with minute bristles. Median furrow broadened behind the middle and ending in a depression. Hind margin with typical fringe of bristles consisting of 6-8 long bristles interspersed with shorter ones. On the dorsal surface the bristles in front of the halteres pits vary in number from 13-16.

Legs.—Front coxæ slightly more than twice as long as broad, lightly beset with bristles, otherwise the legs resemble those of *multispinosa*.

♀ *Abdomen.*—(Dorsal aspect) (Pl. xxiii, fig. 11.) *Basal tergite* large, trapezoidal, and bearing on the disc a number of short bristles, the posterior margin darkly pigmented, widely sinuate, and bearing on either side of the groove a row of 9 long and 4 small bristles of which the median are the longest. The number is subject to variation. The long bristles extend half the length of the next tergite, and provide one of the chief differentiating features of the species. *Tergite* 2 long, subchordate, divided longitudinally by a faint irregular line. Each side is convexly curved anteriorly, and concavely sinuate posteriorly, its posterior margin being produced into an acuminate process with the apex directed outwards. Each acuminate process bears 4-6 long stout bristles, equal in length to the longest of the preceding tergite, and in front are 6 small stout thorn-bristles, though the numbers are not always constant. On each side of the dividing line occur a few short bristles, while a group of small bristles are present at each anterior angle, and some scattered ones on the disc near the lateral margins and extending from the anterior margin to the lateral concavity. A series of 4-5 moderately long bristles is borne on the lateral margins. Below the acuminate processes is a chitinous area carrying on its rounded posterior margin 5-6 sub-erect

bristles situated towards the lateral angles. *Anal segment* broader than long, its surface bare. Anteriorly each side is convexly curved while the hind margin is emarginate. Three or four bristles occur on the lateral margins, and 2 long and 3 short bristles are present on each posterior angle.

(Ventral aspect) (Pl. xxiii, fig. 10.) *Basal sternite* with middle line clearly furrowed, the surface with irregular rows of short bristles. Ctenidium with approximately 70 spines.

The abdomen is deeply indented at the sides in the holotype, owing to the collapse of the connexival membrane between the third and fourth sternites.

Sternite 2 short, and in the holotype almost entirely hidden by the spines of the ctenidium and a fold of the connexival membrane. *Sternite* 3 short, bare, its posterior margin indicated by a row of bristles. *Sternite* 4 similar to preceding, but the bristles on the posterior margin are longer, particularly towards the sides. A few bristles are present at the sides in front of the posterior marginal row. *Sternite* 5 longer than the preceding sternites, and bearing two rows of bristles, a posterior marginal row of long bristles, and an inner row of small bristles. *Subgenital plate* broad, membranous, bare, though at the posterior end, on the disc, occurs a row of short bristles. Between this row and the posterior margin are situated two pairs of long sub-erect bristles. Posterior margin rounded, and bearing a row of 14 long and a few short bristles.

♂ *Abdomen*.—(Dorsal aspect) (Pl. xxiii, fig. 8.) *Basal tergite* small, trapezoidal, fore-shortened, and bearing a number of short bristles. *Tergite* 2 bearing irregular rows of curved small bristles on the disc, and a posterior marginal row of long bristles interspersed with small ones. Lateral margins strongly pubescent. *Tergites* 3 and 4 with irregular rows of small bristles on the disc, and a posterior marginal row resembling that of the preceding tergite. *Tergite* 5 resembles tergite 3-4, but the bristles on the disc are fewer in number and the tergite is chiefly bare. *Tergite* 6 similar to preceding, but some of the median long bristles extend more than half-way down the next tergite. A row of small bristles occurs in front of the posterior marginal row. *Anal segment* moderately long and blunt, bare towards the anterior margin, otherwise covered with short bristles and with two long erect bristles in the apical third. At the sides are a number of bristles, while two long and three short bristles spring from each posterior angle.

(Ventral aspect) (Pl. xxiii, fig. 7.) *Basal sternite* resembles that of the female, but the small bristles on the disc are closer together. Ctenidium with approximately 60 spines. *Sternite* 2 with three rows of small bristles on the disc their length increasing towards the lateral margins. Posterior margins with long bristles, many of which reach to the border of the next sternite. *Sternite* 3 bare in the middle, but a few small bristles are present towards the lateral margins. On the posterior margin is a series of long bristles, and an inner widely spaced row of small bristles. *Sternite* 4 as long as the two preceding sternites. Posterior margin curved, bearing in the middle short, stout, thorn-bristles arranged in two rows, one on the margin of 14, the other in front, of 13 bristles. On the posterior margin also occurs a number of bristles, those at the posterior angles

being the longest. In front of the marginal series is a row of slender bristles. Disc bare, except for a few short bristles towards the lateral margins. *Anal segment* with a number of bristles at the sides towards the basal end. Claspers strong, black-pigmented, extending to the anterior margin. On the outer side of each clasper are a series of 7 slender bristles with their apices directed outwards, and towards the base are some short bristles, and a single long bristle directed downwards.

Hab.—New South Wales: Sans Souci, Botany Bay, Sydney, 20th September, 1923, 4 ♀ 2 ♂, on *Scoteinus rüppellii* Peters, collected by Mr. J. H. Wright; Ropes Creek, 1 ♀, on *Scotophilus* (?) *sp.*

Types.—Holotype ♀, register number K 51807, allotype ♂, register number K 51805, and remaining five paratypes are mounted in Canada balsam and are in the Australian Museum collection.

Material examined.—Two of the females, one from Botany Bay (holotype) the other from Ropes Creek, have their abdomens distended; two have them normal, while the remaining female is badly damaged. One of the males is immature. The males approximate closely to those of *multispinosa*, but the females are readily distinguishable from any other species by the presence of the long spines on the posterior margins of the basal tergite and tergite 2.

Subgenus LISTROPODA *Kolenati* 1857.

NYCTERIBIA (LISTROPODA) PARILIS *Walker.*

Nycteribia parilis Walker, Journ. Linn. Soc. Lond., v, 1861, p. 300.

Nycteribia (Listropodia) parilis Scott, Ann. Mag. Nat. Hist., (8), xiv, 1914, p. 231, pl. xii, figs. 20-23 ♂ ♀.

Nycteribia (Listropoda) parilis Musgrave, Rec. Austr. Mus., xiv, 4, 1925, p. 298.

Note.—This form hitherto has been unrepresented in the collection of the Australian Museum as I have pointed out in my paper *supra*, but as the result of a recent exchange with Dr. Scott we now possess 3 ♂ 3 ♀ of this species from Amboyna, collected by Mr. F. Muir on *Miniopterus schreibersi*, and identified by Dr. Scott. While on a collecting trip to Prospect Reservoir near Sydney, on July 16th, 1925, a party led by Dr C. Anderson secured a bat, *Miniopterus schreibersi* Natterer, from which they obtained 2 ♂ 1 ♀ *Listropoda*. I associate them with this species, but they are much larger than the specimens of *Nycteribia* (*Listropodia*) *parilis* which I have before me identified by Scott, and they measure 2.5 mm. in length, the specimens from Amboyna measuring only 1.5 mm. One of the specimens was forwarded for identification to Scott who states, "I don't see any very satisfactory characters separating your species from *parilis*, except the great difference in size."

NYCTERIBIA (LISTROPODA) SARASINI *Falcoz.*

Nycteribia (*Listropodia*) *sarasini* Falcoz, Nova Caledonia, Zool., iii, 1923, p. 89, figs. 9-12.

Nycteribia (*Listropoda*) *sarasini* Musgrave, Rec. Austr. Mus., xiv, 4, 1925, p. 299.

Note.—In my paper *supra* I stated that this species was unrepresented in the Australian Museum collection. We have since acquired by exchange with Dr. Scott, 2 ♂ 2 ♀ from Mossman, Queensland, collected by Mr. F. Muir on *Miniopterus schreibersi*, and identified by L. Falcoz.

NOTES ON SOME WESTERN AUSTRALIAN FROGS, WITH DESCRIPTIONS OF NEW SPECIES.

By

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(Figures 1-5.)

The material upon which this paper is based was collected by myself and others during the excursions which formed so interesting a feature of the Perth meeting of the Australasian Association in August last. Two species are described as new, and notes are given upon several others. It is suggested that two previously described species are synonymous with known forms. I have to thank Professor G. E. Nicholls, D.Sc., for his generosity in putting at my disposal his material of the species which I have dedicated to him, as well as for much assistance freely given in several other directions.

Crinia leai *Fletcher*.

Crinia leai Fletcher, Proc. Linn. Soc. N.S.W., xxii, 1897 (1898), p. 677.

Crinia leai Fry, Records W.A. Museum, i, 3, 1914, p. 203, pl. xxviii, figs. 2 and 2a.

Crinia michaelseni Werner, Fauna Südwest-Australiens, iv, 1914, p. 416.
Nineteen individuals collected at Bridgetown, 174 miles south of Perth, 29. viii, 1926.

A larger series was collected, but a number were presented to Professor G. E. Nicholls, who had not himself taken this species. The frogs were found under discarded fence rails lying along an area of damp ground beside a creek on the property of Mr. E. G. Hall, about four miles out of Bridgetown. Fletcher's specimens came from Bridgetown and Jarrahdale; that figured by Fry from the Margaret River. The species has not been recorded from any other locality. If, however, as I suggest, *Crinia michaelseni* Werner is synonymous, then the following localities must be added:—Donnybrook, Boyanup, Lunenberg, Bunbury, and Albany. Professor Nicholls has not found this species in the neighbourhood of Perth, and I did not find it in the wheat-belt country at Narrogin or Merredin, so the range would appear to be through the coastal belt from a little south of Perth to Albany.

This frog is somewhat more variable than the descriptions of Fletcher and Fry (*loc. cit.*, indicate. Less than half of my specimens show the characteristic dark dorsal band, which is most conspicuous in young individuals, and tends to become broken up with advancing age. During

this process, which seems to be initiated by the posterior bifurcation mentioned by Fletcher, the more persistent remnants are the anterior border, lying between the posterior halves of the upper eyelids, and the lateral margins. The anterior border is in only one individual as straight and rectangular as figured by Fry. Usually it is slightly emarginate, and the antero-lateral angles are truncated. In several individuals it persists only as a triangular spot between the eyes, with the apex directed backwards. In some this spot curves outwards and backwards on either side so as to resemble the conventional seabird of old-fashioned seascapes. The lateral margins persist in some individuals as blackish stripes, separated by a lighter grey band; in others they become broken up into lines of irregular spots. Anterior to the dark dorsal band the crown is grey, sometimes reduced to a transverse grey band between the anterior halves of the upper eyelids by the darkening of the snout. Typically a dark band runs from the tip of the snout embracing the nostril to the eye, and is sometimes continued to the shoulder. The triangular dark mark surrounding the vent is usually present. Another characteristic marking, occasionally absent, is the black band running along the outer side of the plantar surface from the tibio-tarsal articulation to the ends of the outer toes. In some examples the plantar surface is completely black. This mark is usually light-edged. An extreme example, which has this marking, has the dorsal surface apparently uniform slaty grey, except for a slightly darker small triangular spot between the eyes. Under the binocular, however, the apparent uniformity is resolved into obscure mottling with two shades of grey and black.

The undersides of body and limbs are creamy white, more or less finely freckled with brown. My series was fixed in Bles' solution before preservation in alcohol, and the coloration exhibited is close to that in life, cold greys, with in one or two individuals only a warming towards brown. Fletcher's type material, on the other hand, which is preserved in the Macleay Museum of the University of Sydney, is spirit material, and the prevailing colour is warm brown.

Though this species obviously comes fairly close to the "smooth" *Crinia* of Victoria and Tasmania, it does not show an interesting modification of the manus which characterises the latter, and with which I propose to deal shortly elsewhere.

CRINIA MICHAELSENI *Werner*.

Crinia michaelseni Werner, Fauna Südwest-Australiens, iv, 1914, p. 416.

Werner writes (*loc. cit.* p. 405):—"anstatt der von Bridgetown und Pipe Clay Creek bei Jarrahdale beschriebenen *Crinia Leai* enthält das *Michaelsen-Hartmeyersche* Material die neue *Crinia Michaelseni*." I can find nothing in his description of *Crinia michaelseni*, however, which distinguishes it from *C. leai* of Fletcher, except for some colour differences which are probably due to spirit preservation. His type comes from Donnybrook, only forty miles from Bridgetown, one of Fletcher's type localities, while a further portion of the material studied by him was from

Fletcher's other type locality, Jarrahdale. *C. michaelseni* appears to be a synonym of *C. leai*.

CRINIA ROSEA *sp. nov.*

Eight individuals collected at Pemberton, in the Karri country, 218 miles south of Perth, 28. viii. 1926.

Diagnostic characters.—A "smooth" *Crinia* of stout *Pseudophryne*-like habit, with short stout limbs. Dark purplish-grey above, with obscure darker markings resembling those of *Crinia leai*. Closely and finely freckled below, males with throat and chest blackish. In life suffused all over with deep rose, which is easily visible on the lighter ventral surface. Arms completely dark, with palmar surface usually white, but in all cases strongly contrasted with the rest of the arm. First toe only half length of second. Strong fold across chest. Vomerine teeth conspicuous.

Types.—Holotype female and allotype male in the Macleay Museum of the University of Sydney. Paratype material will be distributed to the Western Australian Museum, Perth, the Australian Museum, Sydney, the British Museum (Natural History), and the American Museum of Natural History.

Description of holotype female.—Vomerine teeth in two conspicuous convergent ellipsoidal groups behind the choanae, closer to one another than to the choanae. Head two-thirds as long as broad; snout obtusely acuminate, projecting very slightly beyond mouth; slightly shorter than length of eye; canthus rostralis obtuse; loreal region concave; nostril equidistant from eye and tip of snout; distance between nostrils equal to the interorbital width, which is to that of the upper eyelid as three to two; tympanum not visible. Fingers free, almost cylindrical, not fringed, first much shorter and stouter than second; subarticular tubercles moderately distinct. Distance along straightened hind limb from vent to tibiotarsal articulation equal to distance along mid-dorsal line from vent to level of anterior margins of fore-limbs; heels scarcely meeting; tibia contained two and three-quarter times in distance from snout to vent, two-thirds as long as foot. Toes free, cylindrical, pointed; first and second very short; first slightly more than half length of second, which is much less than half length of third; third reaches penultimate joint of fourth, and fifth the antepenultimate; no metatarsal tubercles; sub-articular tubercles not distinct. Upper and lower surfaces smooth save for glandular granular areas extending along sides from angle of jaw and tympanic region almost to the groin, and upon posterior surfaces of thighs. A fold across chest.

Colour above uniform dark purplish-grey, obscurely mottled with darker; legs obscurely cross-barred, plantar surface darker, undersides of toes apparently white, but lightly mottled; arms wholly dark except for palmar surface, first and second fingers, and undersides of third and fourth, which appear white but are lightly mottled. Undersurface minutely freckled with brown, darker round margin of lower jaw. In

life, the whole is suffused with deep rose, which has already changed to a yellowish red in my material, and appears as if it may leach out entirely in time.

Adult ; ovaries with ripe follicles.

Description of allotype male.—The male differs from the female by its smaller size, indicated in the measurements below ; by the blackish coloration of the throat and chest ; and by the possession of a black dorsal stripe resembling that of *C. leai*, which is bifurcated for the posterior two-thirds of its length, so that it continues as two dorso-lateral, somewhat irregular black lines. This marking is very narrowly edged with greyish-white. The legs, also, are more definitely cross-barred with black.

Measurements.—

	Crinia rosea. ♀	*Crinia rosea.* ♂	*Crinia leai.*
Snout to Vent ...	25 mm.	22 mm.	27 mm.
Width of Head	9 mm.	8.5 mm.	9.5 mm.
Width of Body	15 mm.	11 mm.	12 mm.
Forelimb ...	11 mm.	10.5 mm.	12 mm.
Hindlimb ...	29 mm.	27 mm.	37 mm.
Tibia	9 mm.	9 mm.	13 mm.
Knee to Knee ...	18 mm.	17.5 mm.	21 mm.

Affinities.—*C. rosea* most nearly resembles in appearance and coloration a hill form of *C. victoriana* Boulenger which I collected at Marysville, but lacks the bold mottling of the hinder under-surfaces exhibited by that species, and is much more extensively suffused with rose. Moreover it has the first digit of the manus unmodified, while in *C. victoriana* (as also in *C. froggatti*) the first digit is reduced to a metacarpal plus a small module of cartilage which is the sole remainder of the phalanges. It is of interest to note here that in *C. laevis* of Tasmania the metacarpal is capped by an ungual phalange instead of a spherical cartilaginous nodule. The condition on the second Tasmanian smooth *Crinia*, *C. tasmaniensis* Guenther, is not known. This group of *Crinia* falls into two series—*leai*, *froggatti*, and *leavis* on the one hand, and *rosea*, *victoriana* and possibly *tasmaniensis* on the other. The last species is known only, however from the types in the British Museum, though, if I am right as to its affinities, it should occur commonly enough under logs in the hardwood forests. Each of these series is probably derived from a common ancestor. The members of both series in Western Australia have retained an unmodified manus, those of Victoria have become most modified, while the Tasmanian forms, if we may judge from *C. learis*, are intermediate. This does not necessarily indicate western derivation for the group, but it is certainly unexpected.

From *C. leai C. rosea* is distinguished by its stouter build, shorter limbs, and different coloration.

Variation.—The largest male and female have been selected as types. One female was used for dissection, and is not taken into account. Two

other females do not differ much from the holotype, save that both are a little lighter on the under surface, and are rather more definitely striped with black on the dorsal surface. The first finger is much shorter but not stouter than the second as in the type. Two other males generally resemble the allotype, having bifurcated dorsal bands rather better defined, with a triangular lighter grey mark anterior to the dorsal band, with its apex directed forwards also to the end of the snout. In one of these all the markings are light-edged. The cross-barring of the legs also shows more strongly. Without going further into detail here, it may be prophesied that a larger series would exhibit variations parallel to those shown by *Crinia leai*.

Habits.—*C. rosea* is a cryptozoic form, found hiding under logs during the day in wet forest country. So far it is known only from Pemberton, but probably it is generally distributed in the south-western hardwood forests. The stomach of the female dissected contained only terrestrial amphipods. That of the type, which was also examined, was completely filled by a coleopterous larva. The species will probably be found to lay its eggs out of water, after the manner of its allies and of the species of the genus *Pseudophryne*.

PSEUDOPHRYNE GUENTHERI *Boulenger.*
(Figures 1-5.)

Pseudophryne guentheri Boulenger, Brit. Mus. Cat. Batr., 1882, p. 279 pl. xviii, fig. 2.

Amongst some scientific effects of the late D. B. Fry, a herpetologist of great promise who laid down his life in the Great War, which were handed over to me by his parents, is a redescription of this species, together with some drawings, which were intended for publication, but the paper of which they form a part was not completed when Fry left on active service. I have thought it appropriate to include these here.

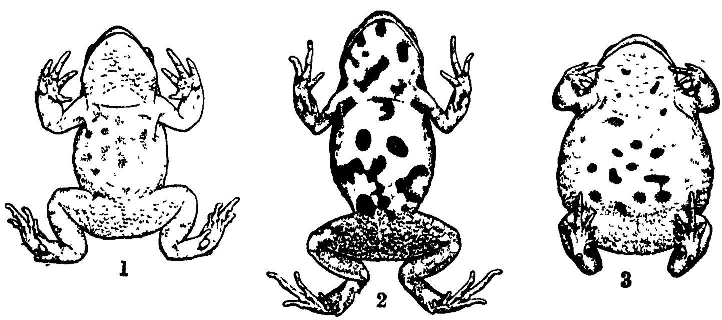
" Habit stout to moderate. Head broad, varying between $\frac{2}{3}$ and $\frac{3}{4}$ long as broad. Snout rounded, very slightly prominent, almost or just as long as the diameter of the eye; nostril nearer the tip of the snout than the eye, save in stout specimens when it is equidistant; canthus rostralis feebly marked, loreal region very slightly concave; interorbital space as broad as the upper eye-lid, flat. Tongue elongate oval, bandlike or cylindrical, entire and free behind. Vomerine teeth absent. Skin very glandular and porous, the whole of the upper surfaces—limbs sometimes excepted—with prominent warts; the scapular region is usually marked by a pair of boomerang-shaped plicae formed of close set, elongate warts; sometimes a row of small warts form an indistinct dorsal line; a pair of glands, varying in distinction beside the urostyle. In some individuals the whole upper surface is finely granular in addition to the warts. Undersurfaces more or less distinctly granular, the anterior $\frac{2}{5}$ of the belly always smooth; a fold across the chest; a marked glandular patch behind the angle of the mouth. Limbs usually short and stout. Fingers cylindrical;

first finger usually a little shorter than the second, in one instance of equal length ; sub-articular tubercles well marked, sometimes raised into pads ; palmar surfaces with tubercles or pads ; a very conspicuous and almost round outer, and a little smaller inner metacarpal tubercle. Foot broad ; toes cylindrical ; plantar surfaces smooth with a large white conical inner and a slightly smaller round outer metatarsal tubercle. The length of the hind limb from the anus to the tarso-metatarsal articulation varies between the distance from the anus to the shoulder and from the anus to the axilla.

Colour (spirits and formalin).—Dark purplish or greyish above, lighter on the forehead, arms and legs. Back variegated with lighter, the markings sometimes almost white, of which one on each shoulder and a more median larger one situated rather in front of the middle of the back, are usually present. Sometimes a stripe from eye-lid to eye-lid and on the urostyle. Some of the warts light tipped. Sides uniform or spotted. Under surfaces pure white or creamy brown, the throat and thighs darkest, with very faint to almost black marblings, varying in number. Limbs variegated or spotted.

The total length of the largest specimen from the snout to the vent is 28 mm.

Localities.—Two adult specimens from Torbay near Albany, King George's Sound, South Western Australia, collected by Mr. W. B. Alexander, B.A. (Figs. 1 and 3). Six specimens in the Macleay Museum, Sydney University, also from King George's Sound have been examined, one of which is figured (Fig. 2). All specimens show considerable differences from Dr. Boulenger's original description and figure, but they seem to be merely individual variations of a most variable species.

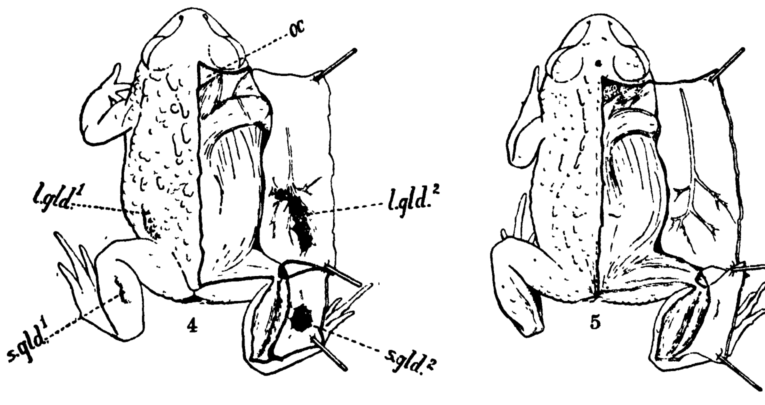


Figures 1-3.
Variation in *Pseudophryne guentheri*. Figures natural size. Drawn by D. B. Fry.

This species differs from its nearest ally, *P. bibronii* by the more warty nature of the skin, by the large parotoid which may be present on the lateral lumbar region, and by the very large metatarsal tubercles. Although these characters make confusion of the two forms impossible

one of my specimens (Fig. 2) shows that the extremes of each species approach each other more closely than the original diagnosis lead one to believe. In this example the back is but little more pustulated than in some examples of *P. bibronii*, and the parotoids figured by Boulenger are not discernible ; the forehead is lighter than the back and the ventral marbling is different from that of specimens of *P. guentheri* and approaches the typical condition of *P. bibronii*. But the metatarsal tubercles are very large. The frog recently described by Andersson[1] from Kimberley district, North Western Australia, as *P. mjöbergi*, differs from *P. guentheri* by the presence of a large paratoid on the shoulder and by an additional tubercle situated ventrally on the proximal end of the tarsus.

The characters of *P. guentheri* subject to noticeable variation are as follows: the width of the head, which in all the examples I have examined is narrower and more rounded than in the type specimen figured by Dr. Boulenger ; the length of the toes and fingers ; the degree of development of the subarticular and metatarsal tubercles ; the length of the hind limb, which may be sexual, the length between the anus and the tarso-metatarsal articulation, varying between the distance of the anus from the axilla or from the shoulder ; the degree of development of the lumbar paratoid gland which may be visible or invisible externally ; and finally, the coloration and markings.



Figures 4-5.
Dissections of *Pseudophryne guentheri*, showing glands present in Fig. 4. absent in Fig. 5. Enlarged. Drawn by D. B. Fry.

The variation exhibited by the " paratoid glands " of this species is a subject worthy of more attention than can be bestowed upon it at present. From the outlook of the systematist the presence or absence within the one species of these glandular masses is very important.

Of the specimens of *Pseudophryne guentheri* examined, only three have been dissected. In one alone were the glands visible externally, and

[1]Andersson—Kungl. Sv. Vet. Akad. Handl., lii, 4, 1913, p. 19, pl. i, figs. 5-6.

then not distinctly, being quite unlike the prominent swellings shown in Boulenger's figure of the type. In one specimen (Fig. 4) the lumbar gland is a diffuse mass, some of the individual glands being quite isolated and there is a somewhat similar patch of glands on the upper side of the shank. The external appearance of these glands, shown on the left side of the figure, is somewhat accentuated. Two other specimens were opened, but they showed no signs of sub-cuticular glands. These glands may, therefore, be present or absent."

I collected adult examples of this frog in the Geraldton district (5.ix.1926), as well as a series, of tadpoles and recently metamorphosed young. A description of the former is held over for inclusion in a general paper on the tadpoles of Australian frogs. The young generally resemble the adults, and have the characteristic metatarsal tubercles well developed, but differ as regards the ventral surface in having the belly darker, owing to the pigmented viscera showing through the skin, and contrasting strongly with the white of the throat and undersides of thighs.

PSEUDOPHRYNE MJÖBERGII *Andersson.*

Pseudophryne mjöbergii Andersson, K. Svensk. Vetens. Akad., Handl. lii, 4, 1913, p. 19, pl. i, figs. 5-6.

I suggest with some diffidence that this species is synonymous with *Uperoleia marmorata* Gray. The latter has a very wide range, and is extremely variable. I have not seen Western Australian specimens of it, but those from Port Darwin in the Macleay Museum, as well as others from Eidsvold in Queensland have the gland pattern just as described by Andersson, and I cannot find any character in his description which definitely distinguishes his species from Gray's.

PSEUDOPHRYNE NICHOLLSI, *sp. nov.*

Twenty-eight individuals collected at Pemberton, in the Karri country, 218 miles south of Perth, 28.viii.1926; four young and two half-grown collected at Deep River, Nornalup, on the south coast by Professor G. E. Nicholls, 30.xi.1925.

Diagnostic characters.—A small *Pseudophryne* of the *bibronii* type, the largest specimen measuring 24 mm. from snout to vent. Bluish to brownish black above and on the sides. Belly ranging from intense black in young to mottled with white in adults ; throat black. A characteristic series of cadmium yellow spots developed as follows :—a pair on each side of the chest, opposite the arms but not extending into the axilla ; a pair on the lower belly in front of thighs, sometimes confluent ; and three on each hind-limb, the first on the underside of the thigh at its distal end, extending into the popliteal region, the second practically continuous with this on the underside of the shank, and the third on the upper and inner side of the foot.

Types.—Holotype female and allotype male in the Macleay Museum of the University of Sydney. Paratype material will be distributed to the Western Australian Museum, Perth, the Australian Museum, Sydney, the British Museum, and the American Museum of Natural History.

Description of holotype female.—Vomerine teeth absent. Head scarcely two-thirds as long as broad; snout rounded, not projecting beyond mouth; slightly shorter than length of eye; canthus rostralis rounded; loreal region concave; nostril nearer to tip of snout than to eye; distance between nostrils less than interorbital width; tympanum not visible. Fingers free, cylindrical, first a little shorter than second; subarticular tubercles distinct. Distance along straightened hind limb from vent to tibiotarsal articulation measured along mid-dorsal line from vent falls a good deal short of level of arms; heels not meeting by at least 3 mm.; tibia contained three and one half times in distance from snout to vent, seven-eighths as long as foot. Toes free, cylindrical, pointed; first and second very short, first shorter than second; third very slightly longer than fifth, and half the length of fourth; two not very distinct metatarsal tubercles, the outer larger than the inner; subarticular tubercles moderately distinct. Upper surface coarsely granular laterally, the granules merging into indistinct rows of low warts in the mid-dorsal region. Whole ventral surface and undersides of thighs coarsely granular, rather finer on the throat.

Colour.—Uniform dark brown above, with blackish markings not very well defined, comprising a spot surrounding nostrils, a band between eyes, an irregularly cross-shaped marking behind the eyes, and three indistinct lines along the back, one mid-dorsal, the others dorso-lateral; a faint light stripe on the urostyle; legs finely mottled black and brown above, black and white below, with the three cadmium yellow spots mentioned above, a white spot on the upper side of the foot distal to the cadmium spot, and white tips to the toes; arms mottled in the same way above and below with no conspicuous spots and tips of fingers white. Undersurface blackish grey marbled with white, darker on the throat, with cadmium spots at level of arms, and confluent in front of thighs. In life the frog appeared much darker.

Description of allotype male.—The male does not differ from the female in any important particular. The type has the throat intensely black, and the dorsal black markings more distinct, but these will be discussed under variation.

Measurements.—

	♀	♂
Snout to vent ...	25 mm.	23 mm.
Width of head ...	8 mm.	8 mm.
Width of body ...	12 mm.	10 mm.
Forelimb	10 mm.	10 mm.
Hindlimb	21 mm.	22 mm.
Tibia	7 mm.	7.5 mm.
Knee to knee ...	13.5 mm.	15 mm.

Affinities.—Professor Nicholls in his account of the zoology of South Western Australia published in the Handbook for the Perth meeting of the Australasian Association for the Advancement of Science, 1926, refers this frog to *P. dendyi* Lucas.[2] The latter was described from Gippsland, Victoria, and from a single specimen which has apparently since been lost, as it is not amongst the *Pseudophryne* in the collection of the National Museum, Melbourne. It may have been a young individual of a large *Pseudophryne* from Gippsland which I have before me, or it may be identical with or allied to a small dark form which I have taken on the north coast of New South Wales, from Port Stephens to Port Macquarie. Whatever it was, it is clearly distinguished from the species under discussion by its smooth belly, and by the yellow mark on the forelimb. A white or yellow mark in this position is of common occurrence amongst species of *Pseudophryne*, but is totally absent in *P. nichollsi*, the very granular belly of which distinguishes it from all other species of the genus.

The status of the species of *Pseudophryne* has been called in question by Andersson.[3] Boulenger, in his Catalogue, allowed four species, namely *australis*, *bibronii*, *coriacea*, and *guentheri*, with a note that the second and third " may prove to be mere varieties of *P. australis*." Lucas[2] described two additional species, *dendyi* and *semimarmorata*, but in " Animals of Australia " (1909), written in collaboration with W. H. Dudley le Souëf, reduces the latter and *P. coriacea* to colour varieties of *P. bibronii*, allowing *P. australis* as distinct. Andersson in his earlier paper, without having seen *P. australis*, writes (p. 18) : " Considering only the characteristics which are usually employed for distinguishing species of frogs, I can . . . call them *Ps. australis* quite as well as *Ps. bibronii* . . . The small differences in colour, used by Fletcher as an important characteristic as well, are not much more reliable than 'habits and temperament.' As is well known, the colour of the batrachians varies in a high degree in most species." In the later paper he claims definitely that *P. australis* and *P. bibronii* should be united under the former name, and appears totally unaware that the specimens he is discussing belong to *P. coriacea*. Incidentally he has described two new species of *Pseudophryne*, *P. mjöbergii* and *P. rugosa*, both of which, so far as I am able to judge, are synonymous with *Uperoleia marmorata*, and are not *Pseudophryne* at all.

I have already discussed the relationship between *P. australis* and the typical form of *P. bibronii*,[4] and shown that they are totally distinct in habitat and life history. Therefore they are not merely colour varieties of a single species, but totally distinct species. If conventional herpetological methods cannot express this distinction, then we are justified in using colour which clearly does express it, since there is no intergrading between the two forms. Similarly *P. coriacea* and *P. semimarmorata* are, in my opinion, both good species, as is the small dark form from the

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[2]Lucas—Proc. Roy. Soc. Victoria (n.s.), iv, 1891 (1892), pp. 62-63.
[3]Andersson—Kungl. Sv. Vet. Akad. Handl., lii, 4, 1913 ; lii, 9, 1916.
[4]Harrison—Australian Zoologist, iii, 1, 1922, p. 26

north coast of New South Wales, which may be identical with *P. dendyi*. I have an account of this genus in preparation, so need not discuss the matter at greater length here. The new species I describe is distinguished by a morphological character, the granulated abdomen, as well as by a characteristic coloration, but I should have felt fully justified in founding it upon the latter alone.

Variation.—The series which I personally collected at Pemberton was taken upon a limited area, and does not show any very striking variation, except that which marks the successive growth stages. The smallest individual measures 14 mm. from snout to vent, is very granular—almost papillose—on the ventral surface, and is dense black above and below, except for the four cadmium spots on the abdomen, those in front of the thighs confluent, and the spots of the same colour on the legs. The marbling of the abdomen has not yet commenced. The characteristic dorsal markings are visible, but they show more clearly in individuals of a somewhat larger size, and comprise a black bar between and upon the eyelids, sometimes broken into three spots, and sometimes with an isolated spot in front ; a cross-shaped mark formed by two lines of warts running from the back of the eyes to the shoulders of the opposite side ; and some obscure lines on the lower half of the back. A very narrow light ventral line is present in some of the younger individuals, which persists in others as a faint coccygeal stripe ; while in a few there is a fine light line from above the vent along the backs of the thighs. The marbling of the belly varies between a "pepper and salt" condition and one in which the appearance is that of black confluent blotches upon a white ground. The throat is always darker.

Professor Nicholls' series indicates that a wider range of variation may be expected when this frog is collected from different localities. The four young individuals are uniform black above and below, with indications of the cadmium spots on the legs. In only one are the breast spots visible to the naked eye, but a lens reveals them in all. The spots in front of the thighs are the last to appear. The smallest of these is 10 mm. from snout to vent, and the largest 12·5 mm. A larger individual 17 mm. in length still has the abdomen completely black except for the two breast spots, but the leg markings are present. The largest specimen 20 mm. in length, has the typical dorsal pattern, a granular "pepper and salt" abdomen, and only a bare indication of the yellow spots.

Habits.—My specimens are from under logs in damp forest country ; those of Professor Nicholls from moss in a small creek. The stomachs of two individuals which were opened contained small black ants.

MYOBATRACHUS GOULDI *Guenther.*

A large female of this remarkable species, measuring 48 mm. from snout to vent, was captured by Dr. E. W. Ferguson under a stone on a dry hilltop in the sand plain country at Eradu, east of Geraldton. The stomach was crammed with comminuted termites, mixed with the fine reddish sand of the country. The ovarian follicles were well developed, measuring upwards of 3 mm. in diameter.

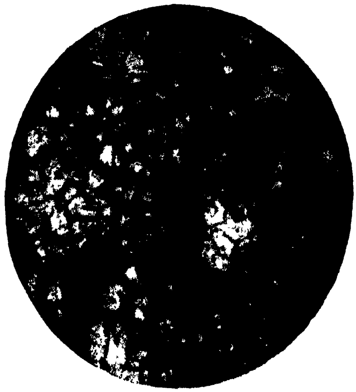
EXPLANATION OF PLATE XVIII.

Fig. 1. *Heliolites yassensis* Dun. (Australian Museum Collection, Reg. No. F. 5176.)

,, 2-3. *Heliolites regularis* Dun. Hatton's Corner, Yass, New South Wales. (Mining Museum Collection, Reg. No. 174.)

,, 4-5. *Heliolites regularis*, var. *humewoodensis* Dun. Old Limekilns Ridge, Humewood. (Mining Museum Collection, Reg. No 585.)

,, 6. *Heliolites jackii* Dun. Hatton's Corner, Yass, New South Wales. (Australian Museum Collection, Reg. No. F. 5174.)



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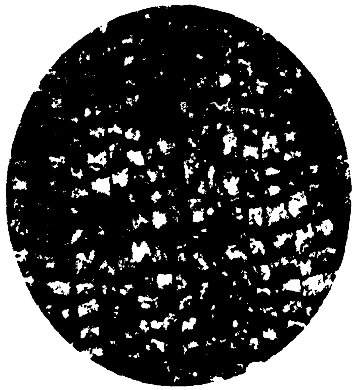

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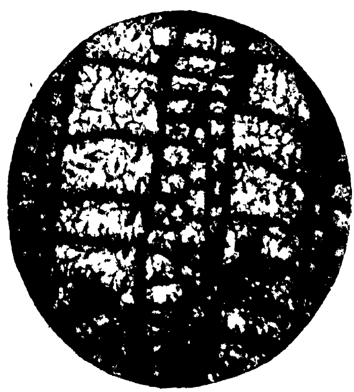

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T. WHITELEGGE AND H. BARNES, micro-photo.

EXPLANATION OF PLATE XIX.

Figs. 1-2. *Heliolites jackii* Dun. Hatton's Corner, Yass, New South Wales. (Australian Museum Collection, Reg. No. A.M. 607.)

,, 3-4. *Heliolites distans* Dun. (Mining and Geological Museum, Sydney. Reg. No. F. 1828.)

,, 5-6. *Heliolites distans* Dun. (Australian Museum Collection, Reg. No. 5178.)

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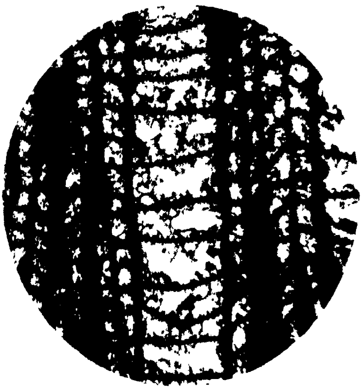
T. WHITELEGGE AND H. BARNES, micro-photo.

EXPLANATION OF PLATE XX.

Figs. 1-2. *Heliolites distans,* var. *humewoodensis* Dun. Old Limekilns Ridge, Humewood. (Mining and Geological Museum, Sydney, F. 3616.)

,, 3-4. *Heliolites distans,* var. *humewoodensis* Dun. Old Limekilns Ridge, Humewood. (Australian Museum, F. 4082.)

,, 5-6. *Heliolites distans,* var. *intermedia* Dun. Old Limekilns Ridge, Humewood. (Australian Museum, F. 5556.)



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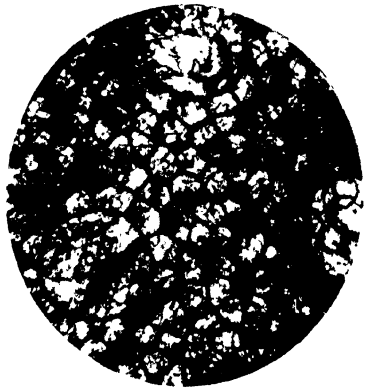

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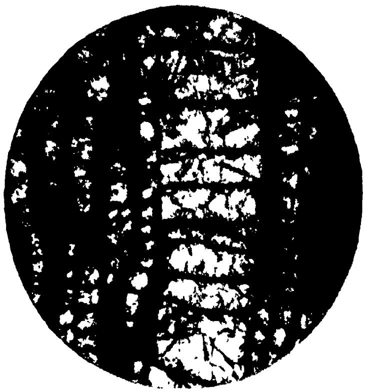

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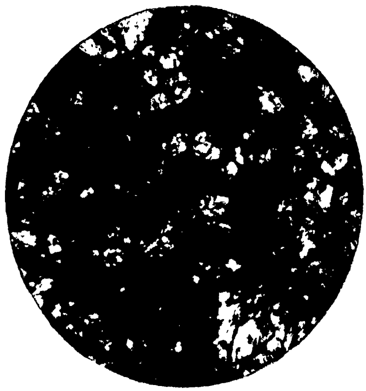

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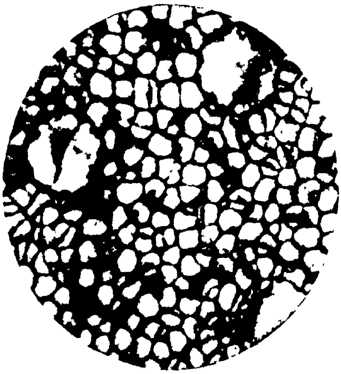
T. WHITELEGGE AND H. BARNES, micro-photo.

EXPLANATION OF PLATE XXI.

. 1-2. *Heliolites distans*, var. *minuta* Dun. Old Limekilns Ridge, Humewood. (Australian Museum, F. 5555.)

„ 3-4. *Heliolites distans*, var. *minuta* Dun. Old Limekilns Ridge, Humewood. (Australian Museum, E. 34.)

„ 5-6. *Plasmopora shearsbyi* Dun. Hatton's Corner, Yass. (Australian Museum.)



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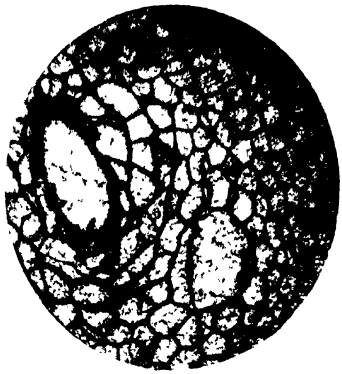

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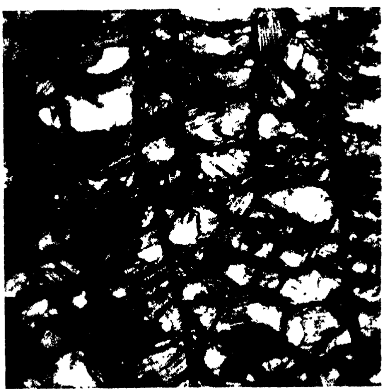

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T. WHITELEGGE, H. BARNES AND G. C. CLUTTON, micro-photo.

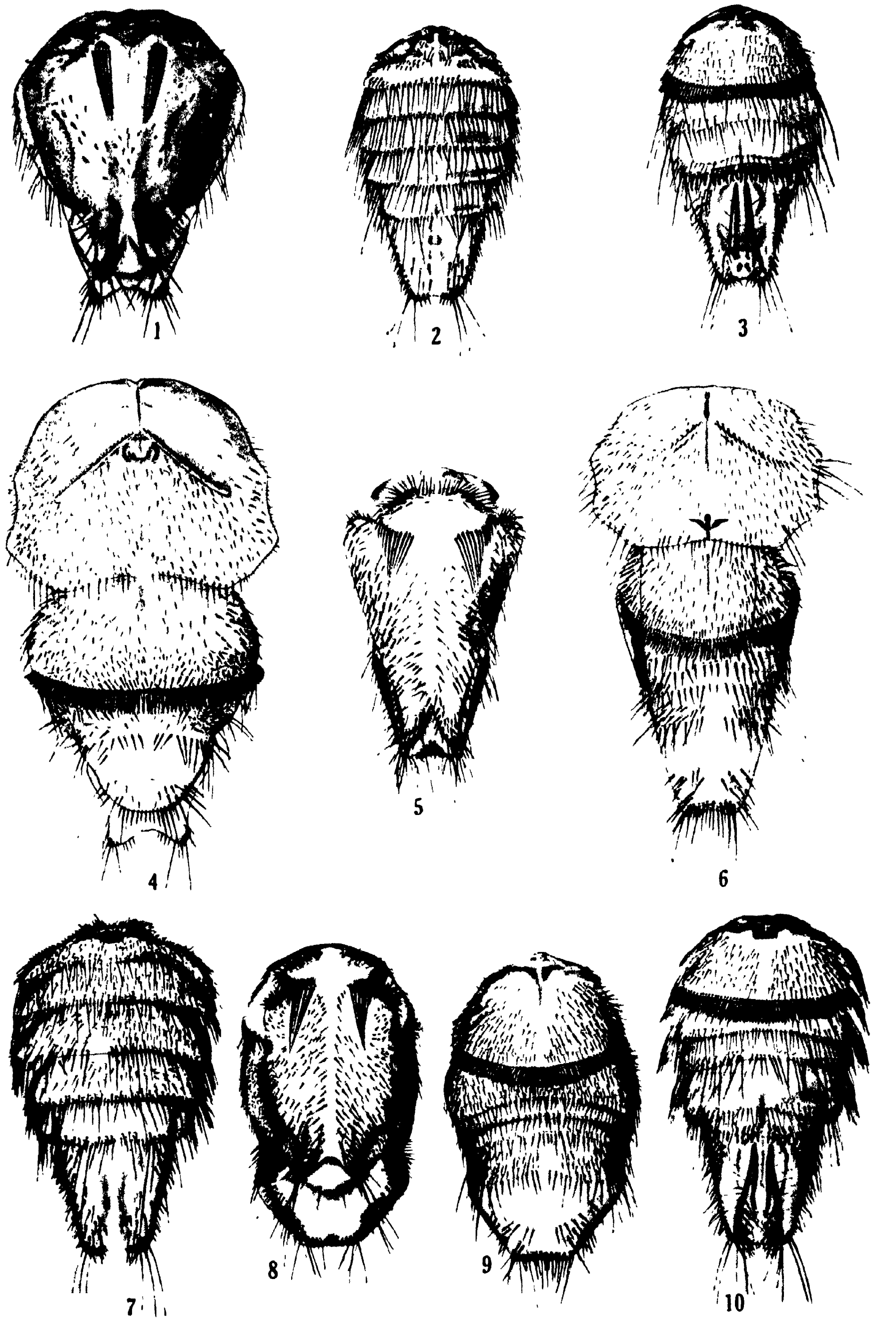
EXPLANATION OF PLATE XXII.

Nycteribia (*Nycteribia*) *troughtoni*, sp. nov.

Fig. 1. Female holotype, dorsal view of abdomen.
,, 4. ,, ,, ventral view of thorax and abdomen.
,, 2, 3. Male allotype, dorsal and ventral views of abdomen.

Nycteribia (*Nycteribia*) *multispinosa*, sp. nov.

,, 5. Female holotype, dorsal view of abdomen.
,, 6. ,, ,, ventral view of thorax and abdomen.
,, 8, 9. Female paratype, dorsal and ventral views of abdomen, showing distention.
,, 7, 10. Male allotype, dorsal and ventral views of abdomen.



JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XXIII.

Nycteribia (*Nycteribia*) *halei*, sp. nov.

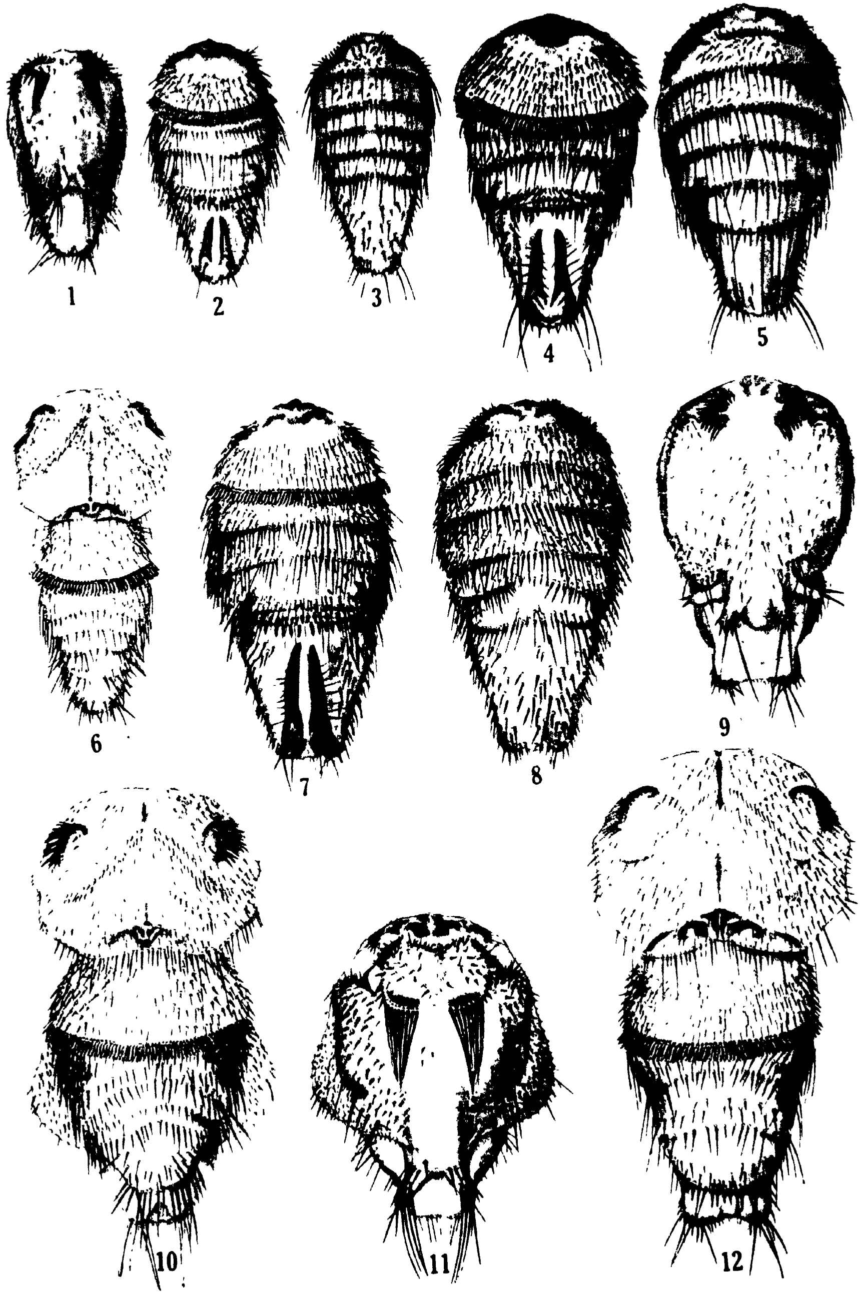
Fig. 1. Female holotype, dorsal view of abdomen.
,, 6. ,, ,, ventral view of thorax and abdomen.
,, 2, 3. Male allotype, ventral and dorsal views of abdomen.

Nycteribia (*Nycteribia*) *burrelli*, sp. nov.

Fig. 9. Female holotype, dorsal view of abdomen.
,, 12. ,, ,, ventral view of thorax and abdomen.
,, 4, 5. Male allotype, ventral and dorsal views of abdomen.

Nycteribia (*Nycteribia*) *longispinosa*, sp. nov.

Fig. 10. Female holotype, ventral view of thorax and abdomen.
,, 11. ,, ,, dorsal view of abdomen.
,, 7, 8. Male allotype, ventral and dorsal views of abdomen.



JOYCE K. ALLAN, del.

STUDIES IN ICHTHYOLOGY.

No. 1.

By

GILBERT P. WHITLEY, Zoologist, Australian Museum.

(Plates xxiv-xxv and Figure 1.)

Under the heading " Studies in Ichthyology," I propose to contribute from time to time a series of papers dealing with fishes, mostly from Australia, as miscellaneous notes and figures accumulate.

It is a pleasure to acknowledge the courtesy of Mr. H. A. Longman, F.L.S., Director of the Queensland Museum, and of Mr. T. C. Marshall of the same institution in affording me facilities for examining many of the fishes in their custody, when recently in Brisbane. Only a few of the species then noted are dealt with here; I intend to include my notes on the others in a paper, in course of preparation, on some North Queensland fishes.

Family ORECTOLOBIDAE.

ZEV *gen. nov.*

Cirrhoscyllium Smith, Proc. U.S. Nat. Mus. xlv, June 21st 1913, pp. 567, & 568. *Ex* Smith & Radcliffe MS. Orthotype *Cirrhoscyllium expolitum* Smith, *loc. cit.* Not *Cirriscyllium* Ogilby 1908, a genus in the same family.

Smith's genus *Cirrhoscyllium* must not be confused with *Cirriscyllium* Ogilby[1] (orthotype *Chiloscyllium modestum* Günther) which belongs to the same family as *Cirrhoscyllium* and also renders that name preoccupied. I propose the new name *Zev* for *Cirrhoscyllium* Smith 1913 (not *Cirriscyllium* Ogilby 1908) with *Z. expolitus* as genotype.

Cirriscyllium Ogilby is a synonym of *Brachaelurus* Ogilby 1907[2] with the same species, *Chiloscyllium modestum* Günther, as genotype. *Brachaelurus* Ogilby 1908[3] (orthotype *Brachaelurus colcloughi* Ogilby, *loc. cit.* Not *Brachaelurus* Ogilby 1907) is a synonym of *Heteroscyllium* Regan[4] (orthotype *Heteroscyllium colcloughi* Ogilby).

Family PRISTIDAE.

PRISTIS ZIJSRON *Bleeker*.

Pristis zijsron Bleeker, Nat. Tijd. Ned. Ind. ii, 1851, p. 442. Bandjermassing, Borneo. *Id.*, Whitley, Austr. Mus. Magazine, iii, 1, 1927, p. 21, 4 figs.

A female sawfish (*Pristis zijsron* Bleeker), 16 feet long, was harpooned by life-savers off the ocean beach at Manly, near Sydney, on 10th

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[1]Ogilby—Proc. Roy. Soc. Qld., xxi, 1908, pp. 2 and 4.
[2]Ogilby—Proc. Roy. Soc. Qld., xx, 1907, p. 27.
[3]Ogilby—Proc. Roy. Soc. Qld., xxi, 1908, pp. 2 and 3.
[4]Regan—Ann. Mag. Nat. Hist., (8), ii, 1908, p. 455.

October, 1926. In preparing a popular article for the "Australian Museum Magazine," I accumulated certain notes, which, being of a technical character, would more appropriately appear in the pages of this journal.

The measurements of the Manly specimen were as follows. Total length 191 inches; rostrum $58\frac{1}{2}$; width at pectorals 52. The weight was not ascertained. This size is not a record as two specimens from Ballina, northern New South Wales, are reported on good evidence to have measured 22-24+ feet long; 6 feet 6 inches-7 feet girth; 4 feet 4 inches-5 feet 6 inches length of rostrum.

Head of Manly specimen.—Length from posterior level of nostrils to first tooth of saw (12 inches) equal to width of head at level of eyes. Mouth to posterior level of nostrils $4\frac{5}{8}$. Width at anterior level of nostrils $10\frac{3}{8}$. Distance between nostrils $3\frac{1}{8}$; olfactory laminae $2\frac{1}{2}$; nostril to side of head $1\frac{5}{8}$. Eye $1\frac{1}{4}$; interorbital width $9\frac{1}{2}$, equal to width of mouth; spiracle $2\frac{7}{8}$. 28 teeth on left, 25 on right side of rostrum.

Colour.—General colour, when fresh, greenish-grey, becoming lighter and yellowish on the sides, edges of fins and rostrum, around the eyes, and along the posterior margins of the spiracles. Ventral surface whitish. A yellowish mark in a slight pit on median line before the eyes at the origin of the rostrum. Pupil black, with a silvery ring, protected by a triangular whitish flap which overhangs it. Rest of eye greyish, darker inferiorly. Dorsals dirty yellowish-grey, the first originating above the middle of the ventrals and subequal to the second.

A search was made for external, internal, and branchial parasites, but, excepting four Sucking-fishes (*Echeneis naucrates* Linnæus) attached to the body, and a few nematodes in the stomach, no parasites were revealed.

Ovarian eggs of various sizes were present and each uterus was completely filled by five large yolk-masses or eggs, but no embryos were traceable.

Pristis zijsron is usually found in estuaries, sometimes in fresh water, in Indo-Australian waters. It is the only species of the genus so far recorded from New South Wales. The Australian Museum has a specimen from the Parramatta River, apparently the southernmost locality recorded for this species.

Family SYNODONTIDÆ.

TRACHINOCEPHALUS MYOPS (*Bloch & Schneider*).

Salmo myops Bloch & Schneider, Syst. Ichth., 1801, p. 421. *Ex* Forster MS. St. Helena.

Saurus limbatus Eydoux & Souleyet, Voy. "Bonite," Poiss., 1842, p. 199, pl. vii, fig. 3. Locality unknown (= Hawaii).

Synodus myops Bleeker, Atlas Ichth., vi, 1875, p. 153, pl. cclxxviii, fig. 3.

Goodella hypozona Ogilby, Proc. Linn. Soc. N.S. Wales, xxii, 2, 1897, p, 250. New South Wales beaches.

Trachinocephalus myops Waite, Rec. Austr. Mus., v, 4, 1904, p. 232.

A specimen, 43 mm. in total length, has the following characters:—D. 12; A. 14; P. 12; V. 8; C. 17. L. lat. 53.

Longitudinal diameter of orbit (3 mm.) twice the length of the snout

(1.5), and 3.3 in the head (10) which is 4.3 in the total length (43). Depth at base of ventrals (6) 7.1 in the same. Long sharp teeth on the maxillaries, mandible, and palatines; none on vomer.

General colour yellowish, whiter below. Eleven broken dark patches at intervals along the back, the first nine of which have lateral dark patches below and slightly behind them. A black mark on the upper opercular border. Eye opalescent greenish.

Loc.—Gunnamatta Bay, Port Hacking, New South Wales; stranded on a sand-bank, 13th February, 1926, coll. G. P. Whitley. Australian Museum Regd. No. IA.2627.

Remarks.—This specimen is of interest because it has the external characters of an adult, yet is only 43 mm. long. *Goodella hypozona* Ogilby, which has been regarded as probably the young of *Trachinocephalus myops*, retains its larval characters at least up to a length of 48 mm.; it has been found cast upon New South Wales beaches in January and February, and is said to be quite transparent when alive. It may decrease in size during metamorphosis in a manner similar to the shrinking of the *Leptocephalus* which becomes an elver.

Should later research show that there are specific differences between the *Trachinocephalus* of the Pacific and *T. myops* of the Atlantic, our form will have to be called *T. limbatus* Eydoux & Souleyet. Specimens are in the Australian Museum from various localities on the New South Wales coast, Lord Howe Island, New Hebrides, and Madras, India (Day). The species has been recorded from Houtman's Abrolhos and southern Queensland.

Family ARIIDAE.

ARIUS GAGORIDES (*Cuvier & Valenciennes*).

?*Pimelodus sona* Hamilton-Buchanan, Acc. Fish. Ganges 1822, pp. 172, 376 (*fide* Day).

Bagrus gagorides Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 1839, p. 441. Bengal.

Bagrus trachipomus Cuvier & Valenciennes, *Op. cit.*, p. 443. (Bengal.)

Arius gagoroides Bleeker, Verh. Batav. Genootsch. Wetensch., xxi, 1, 1846, p. 34.

Arius sona Day, Fish. India 1878, p. 462, pl. cv, fig. 2.

Arius gagorides Weber & Beaufort, Fish. Indo-Austr. Archip., ii, 1913, pp. 274 & 288.

A specimen (Austr. Mus. Regd. No. IA.2663), approximately 560 mm. in total length, agrees in detail with a Calcutta example from Day's collection, labelled as *A. sona* (B.7953), which is 345 mm. long. It was collected by Mr. David G. Stead at Bandar Maharani, Malay Peninsula.

I am not certain whether the name *sona* is applicable to this species or not because Hamilton-Buchanan's work is not available to me.

Family MURŒNESOCIDÆ.

MURŒNESOX ARABICUS (*Bloch & Schneider*).

Muraena cinerea Forskal, Descr. Anim. 1775, p. x (*nomen nudum*).

Muraena tota cinerea Forskal, *Op. cit.*, p. 22. Not binomial. Djedda, Red Sea.

Muraena myrus var. *tota cinerea* Gmelin, Linn. Syst. Nat., ed. 13, i, 3, 1789, p. 1134. *Ex* Forskal. Red Sea.

Muraena arabica Bloch & Schneider, Syst. Ichth., 1801, p. 488. Based on *Muraena cinerea* and *tota cinerea* Forskal. Red Sea.

This species has been called *Muraenesox cinereus* (Forskal) by many authors but, as Sherborn (Ind. Anim. 1902, p. 213) has pointed out, *Muraena cinerea* Forskal 1775 is a *nomen nudum* ; Forskal's name should not be confused with the distinct species *Muraena cinerea* Bonaterre [Tabl. Encycl. Meth. (Ichth.) 1788, p. 35] from Guinea, based on No. 162 of Gronow's Zoophylacium, which was doubtfully referred to *Muraena helena* Linnæus by Meuschen in his index to Gronow's work (1781). Forskal's second name for his species, *tota cinerea,* is not binomial. The next writer on the species is Gmelin (1789) who regards it as a variety of *Muraena myrus* Linnæus. Its specific status is vindicated by Bloch & Schneider in 1801, and their name *Muraena arabica* is, in my opinion, the first valid one for the Red Sea species. Later synonyms have been listed by Jordan & Snyder (Proc. U.S. Nat. Mus., xxiii, 1901, p. 857). The original spelling of the generic name is *Murænesox* (McClelland, Calcut. Journ. Nat. Hist., iv, 1844, p. 408).

Family MURAENIDAE.

MURAENA AUSTRALIAE *Richardson.*

Muraena helena australiae (on plate only) Richardson, Zool. "Erebus" & "Terror" (Fish 1848), p. 80, pl. xlix, figs. 1-6. Australia.

Muraena vorax Ogilby, Proc. Roy. Soc. Qld., xx, 1907, p. 11. New name for *Muraena helena*, Australian form.

Muraena vorax Ogilby has no validity as a specific name, and the manner in which it was proposed leads one to consider it a *nomen nudum*, no references to literature or specimens having been made. Fortunately, Ogilby was anticipated by Richardson, who separated the Australian ally of *Muraena helena* Linnæus from the European species by naming it *Muraena helena australiae* on plate xlix of the Zoology of the Erebus & Terror volume. The date of publication of the plates of this work is unknown to me, but the text concerning *Muraena helena* (p. 80) was issued in 1848. Ogilby's paper was issued as a reprint on 2nd January, 1907.

Family CENTRISCIDAE.

ÆOLISCUS STRIGATUS (*Günther*).

Amphisile strigata Günther, Cat. Fish. Brit. Mus., iii, 1861, p. 528. Java.

Æoliscus strigatus Jordan & Starks, Proc. U.S. Nat. Mus., xxvi, 1902, p. 71, fig. 3. *Id.* Weber & Beaufort, Fish. Indo-Austr. Archip., iv, 1922, p. 20, fig. 10.

Centriscus strigatus Duncker & Mohr, Mitt. Zool. Mus. Hamb., xli, 1925, p. 98, figs. 1-12.

Locomotion.—" A very small specimen was caught by Paymaster P. Stevens of H.M.S. ' Pegasus ' in some weed (*Zostera ?*) in Vila Harbour, New Hebrides, 27. viii. 10. This specimen did not swim vertically, but obliquely and *snout downwards*, The jointed spine was not carried straight out normally but bent downwards at an angle to the body, though, when alarmed, the fish straightened it out and *locked* it. Swimming was

effected by an alternate movement of the pectorals and similarly right v. left movement of the dorsal and anal and *vice versa.* The tail also assisted in this movement, but appeared to be used principally for steering. The fish could dart forwards with sudden rapid movements, while its oblique position in the water would seem to be to enable it conveniently to pick up its food off the sea-bottom. When placed vertically, head upwards, it immediately regained its oblique position, but it occasionally also swam horizontally."—MS. note by the late Allan R. McCulloch.

Distribution in Australia.—Specimens are in the Australian Museum from Clarence River, New South Wales, and Innisfail, North Queensland. This is the first record of the species from New South Wales. *Æoliscus strigatus* has been noted from Cape York by Castelnau[5] and from Bribie Passage, Caloundra, Queensland by Johnston.[6]

Family SYNGNATHIDAE.

SOLEGNATHUS *Swainson.*

Solegnathus Swainson, Nat. Hist. Fish. Amphib. Rept., ii, 1839, p. 333. Haplotype, *Syngnathus hardwickii* Gray 1830. *Id.* Swain, Proc. Acad. Nat. Sci. Philad. (1882) 1883, p. 283.

Solenognathus Kaup, Arch. Naturg., xix, 1, 1853, p. 230, and Cat. Lophobr. Fish., 1856, p. 19 (*emend.*).

Solenostomus Günther, Cat. Fish. Brit. Mus., viii, 1870, p. 516 (*error*).

Solengognathus Kent, Nat. in Austr., 1897, p. 186 (*error*).

Castelnauina Fowler, Proc. Acad. Nat. Sci. Philad. (1907), 1908, p. 426. Orthotype, *Solenognathus spinosissimus* Günther 1870.

Key to Australian species.—

A. Dorsal edges of body and tail continuous; Scutes rugose, but with scarcely any spines; a blackish stripe along dorsal edges......... *danckeri* sp. nov.

AA. Medio-lateral ridge of body continuous with dorsal edge of tail. Dorsal ridges of body and tail discontinuous.

B. Depth of tail behind dorsal 4 or more in base of that fin; depth of snout 6 or more in its length.

C. Orbit less than 4 in snout.

D. Scutes convex, intensely spiny................................*spinosissimus*[7]

DD. Scutes almost flat, one spine on each..............................*fasciatus*[8]

CC. Orbit more than 4 in snout...*guntheri*[9]

BB. Depth of tail behind dorsal about 3 in base of that fin; depth of snout 5 in its length; Scutes slightly convex, with rows of spines radiating from a stronger central spine on each .... *robustus.*[10]

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[5]Castelnau—Res. Fish. Austr. (Vict. Offic. Rec. Philad. Exhib.), 1875, p. 33.

[6]Johnston—Sci. Australian, xxii, 4, 1917, p. 100.

[7]Günther—Cat. Fish. Brit. Mus., viii, 1870, p. 195 (*Solenognathus*). Tasmania

[8]Günther—Voy. Challenger, Zool., i, 6, 1880, p. 30, pl. xiv, fig. B. (*Solenognathus*) Off Twofold Bay, New South Wales.

[9]Duncker—Mitt. Zool. Mus. Hamburg, xxxii, 1915, p. 65 (*Solenognathus*). Houtmans Abrolhos, W. Australia.

[10]McCulloch—Zool. Res. "Endeavour," i, 1911, p. 28, pl. ix, fig. 2. Off Flinders Island, South Australia.

SOLEGNATHUS DUNCKERI, *sp. nov.*

(Plate xxiv, fig. 1.)

Solenognathus hardwickii Waite, Proc. Linn. Soc. N.S. Wales (2) ix, 1894, p. 221, pl. xvii, figs. 2-4 & 7 (" Port Jackson " and " Maroubra " specimens only). Not *Syngnathus hardwickii* Gray 1830.

Solengognathus hardwickii Kent, Nat. in Aust., 1897, p. 186 (" Moreton Bay " record only). Not *Syngnathus hardwickii* Gray 1830.

Solegnathus hardwickii Waite, Mem. N.S.W. Nat. Club, ii, 1904, p. 19. *Id.*, McCulloch, Zool. Res. " Endeavour," i, 1911, p. 28, and Austr. Zool., ii, 2, 1921, p. 38 ; and Check-List Fish. N.S.W. (Austr. Zool. Handbk., i), 1922, p. 28. Not *Syngnathus hardwickii* Gray 1830.

Solegnathus guntheri McCulloch & Whitley, Mem. Qld. Mus., viii, 2, 1925, p. 137. Not *Solegnathus guntheri* Duncker 1915 (Houtmans Abrolhos specimen only).

D. 43 ; A. 4 ; P. 23 ; osseous rings 25 + 58.

Head (69 mm.) 6.7 in the total length when extended (463), 2.4 in the trunk (171). Tail (223) much longer than distance from vent to isthmus (172). Greatest depth (34) 2 in head. Eye (8.5) 8.1 in the same. Depth behind dorsal (12) 5.1 in the base of that fin (62). Postorbital length of head (20) 2 in snout, whose depth (5) is $\frac{1}{8}$ of its length (40) and equal to the interorbital width (5). Width of expanded caudal region (24) 3.3 in its length (80).

Head and body covered with prickly asperities except on the gill-membranes, bases of fins, and brood-area, around the vent, and under the prehensile portion of the tail. Some of the scutes, noticeably those on the nape, have a spine-like tubercle, but most of them are slightly convex and rugose. The median row of scutes along the back is not elevated.

Dorsal fin occupying a sunken area along eleven tail-rings, its radial bases elevated. Dorsal body-ridges beginning behind neck and extending without interruption to end of tail. Medio-lateral body-ridges becoming swollen outwards below the dorsal fin to form a roof-like shelter over the brood-area; they merge into the lateral scutes of the tail at the 13th tail-ring. The lower body-ridges give a V-shaped appearance to the ventral surface. The vent occupies the last body-ring, which is not as deep as the others, and is followed by the soft-skinned brood-area which extends over the ventral surface for about seventeen tail-rings and has well-marked hexagonal pits anteriorly for holding eggs. The ventral ridges of the tail are less marked where they pass over the brood-area to join the infero-lateral body-ridges. Prehensile surface of tail skinny, without excrescences.

General colour (in spirit) yellowish, darker on the tail. A blackish band extends along the scutes forming the dorsal ridges, is continued on to the nape anteriorly, and becomes diffused below the last dorsal rays posteriorly. Lower surfaces of tail, behind brood-area, smoky brown. A faint brown stripe passes obliquely through the blue eye. Fins yellowish, an ill-defined smoky band along the lower part of the dorsal.

This species is readily recognisable by its continuous dorsal and supra-caudal ridges, by the black stripe along its back, and, at least in the males, by the swollen sides below the dorsal fin.

Described and figured from the holotype, 463 mm. long when fully

extended, from Lord Howe Island, where it was collected by Mr. P. R. Pedley. Australian Museum Regd. No. I.14336.

Named in honour of Dr. Georg Duncker, the author of many valuable papers on the family Syngnathidae.

Remarks.—Besides the holotype, there are three specimens of *Solegnathus dunckeri* in the Australian Museum. Two are from Lord Howe Island, and the third is evidently the specimen figured by Waite (*loc. cit.*) as *S. hardwickii*, though it is without definite data. Unfortunately these specimens are dried and damaged so that their fin-rays cannot be counted; their osseous rings, however, vary from 24-26+57-58.

Range.—Lord Howe Island. Kent's record of the species from Moreton Bay, Queensland and Waite's New South Wales records need confirmation before the species can with confidence be regarded as a member of the Australian fauna.

Family PEGASIDAE.

PEGASUS VOLITANS *Linnaeus.*

Pegasus volitans Linnaeus, Syst. Nat., Ed. 10, 1758, p. 338. Amboina.

Zalises umitengu Jordan & Snyder, Proc. U.S. Nat. Mus., xxiv, 1901, p. 2, pls. i-ii. Wakanoura, Japan.

Pegasus pauciradiatus Ogilby, Cat. Fish. N.S. Wales in Rept. Comm. Fisher. N.S. Wales, (1886) 1887, append. a, p. 34. Port Jackson. Holotype in Australian Museum examined.

Mr. J. Bennett obtained a specimen of this species at Gunnamatta Bay, Port Hacking on the 6th June, 1923. This is the second notice of its occurrence in New South Wales, the first being Ogilby's record, quoted above, from Port Jackson. Though Ogilby's holotype of *Pegasus pauciradiatus* appears to the naked eye to have eight pectoral rays, microscopical examination reveals the presence of nine rays in each pectoral fin, and the species, which seems generally to have been overlooked, becomes a synonym of *P. volitans*.

Localities.—Garden Island, Port Jackson, New South Wales; dredged November, 1885. Holotype of *P. pauciradiatus* Ogilby; Regd. No. B.9207.

Gunnamatta Bay, Port Hacking, New South Wales; "salmon haul," June 6th, 1923. Regd. No. IA.1391.

Wilanti, south Malaita, Solomon Islands.

Family ATHERINIDAE.

CRATEROCEPHALUS FLUVIATILIS *McCulloch.*

Craterocephalus fluviatilis McCulloch, Proc. Roy. Soc. Qld., xxiv, 1912, p. 49, pl. i, fig. 1. Narrandera, New South Wales. *Id.*, Waite, Fish. S. Austr., 1923, p. 103.

Habits.—" The McIntyre River was just running, and a stream of thick greyish water from the wool-scour was coming down Middle Creek. I drew a small net below the junction at Inverell and caught a number of Hardyheads (*Craterocephalus fluviatilis*), which were examined and found to be full of roe. Just above the junction the water was perfectly clear. and thousands of Hardyheads were playing about near the surface and

darting in and out of the weeds. The surface was constantly disturbed by their movements. I picked up a specimen from the net and, with thumb and finger, stripped from it a number of eggs, less than the size of a pin's head. Finding the operation very easy, I stripped quite half a dozen, fertilizing the eggs with the milt of the male fishes similarly handled. The eggs adhered to weeds, stones, etc. I then watched closely the movements of the fishes in water that had not been disturbed—the female rubbed herself against the stones on the bottom, evidently assisting the extrusion of the ova. There were invariably three or four male fish which kept close behind the female, and repeatedly swam in beside her, performing similar rubbing movements, just where the female had done." —MS. notes by Mr. H. K. Anderson of the Fisheries Department of New South Wales dated 8th October, 1914, when these observations were made.

Part of the McIntyre (or Barwon) River is on the border of New South Wales and Queensland; *Craterocephalus fluviatilis* extends into the latter State, however, as I have identified specimens in the Queensland Museum from Ithaca Creek, near Brisbane. McCulloch[11] has suggested that this species may be distributed by wind and rain.

Family TRACHIPTERIDAE.

TRACHIPTERUS JACKSONENSIS (*Ramsay*).

(Plate xxv, fig. 2.)

Regalaecus jacksonensis Ramsay, Proc. Linn. Soc. N.S. Wales, v, 1881, p. 631, pl. xx. Manly, near Sydney, New South Wales. Holotype in Australian Museum.

Trachypterus jacksoniensis polystictus Ogilby, Proc. Linn. Soc. N.S. Wales, xxii, 3, 1898, p. 649. Newcastle, New South Wales. Holotype in Austr. Mus.

Trachypterus jacksonensis Stead, Proc. Linn. Soc. N.S. Wales, xxxvii, 3, 1913, p. 492. *Id.*, McCulloch, Austr. Mus. Mag., i, 5, 1922, p. 146.

Trachipterus jacksonensis McCulloch, Austr. Zool., ii, 2, 1921, p. 45, pl. xi, fig. 126a (after Ramsay).

Trachypterus jacksoniensis Marshall, Mem. Qld. Mus., viii, 2, 1925, p. 123.

The following description and the beautiful figure accompanying it were prepared by the late Allan R. McCulloch.

Approximate length from end of snout to tip of tail (incomplete) 1925 mm. Greatest depth 251, breadth behind shoulder 51. Length of the head when the mouth is closed, a little less than the height of the body. Diameter of eye a little less than length of snout; interorbital width about $\frac{2}{3}$ diameter of eye. 50th dorsal ray 100 mm. 8th pectoral ray 115.

Body strongly compressed. The lower profile is straight but the upper is strongly arched; it rises slightly from the nape to its highest point, which is between the first and second fourths of its length, thence it curves steadily downward to the slender tail. Entire body covered with white dermal tubercles which are flattened on the upper parts but change gradually into obtuse points on the ventral surface. They are a little enlarged and arranged in vertical rows on each side of the interneural spines and coalesce to form irregular plates along the lateral line. The lateral line slopes downward from the shoulder till it reaches the middle

[11] McCulloch—Austr. Mus. Magazine, ii, 6, 1925, p. 218.

of the body and thence extends backward to near the tail, where it bends downward to the ventral surface, Anteriorly it is formed of short plates, each bearing a rudimentary central spine, but the plates become much longer posteriorly, the length of each corresponding with those of the caudal vertebrae. The vent is a small opening almost exactly in the middle of the total length and opposite the 80th ray.

Head naked, longer than high. Maxilla and opercular bones membranaceous and striated. Upper profile of head forming an oblique line from the posterior end of the premaxillary processes to the upper lip; when the mouth is closed, the processes reach backward almost to the vertical of the hinder margin of the eye; they curve forward on each side behind the upper lip and in advance of the maxilla. A small pore near the upper surface of the snout, well in advance of the eye, apparently represents a nostril. Maxilla lamellate, more than half as wide as deep, with many striae radiating from its upper portion. Mandible with numerous ridges and grooves. Diameter of eye a little less than its distance from the upper lip when the mouth is closed. Preoperculum moveable upon exposed processes of the quadrate and hyomandibular; its greater surface is densely striated, but it has a smooth membranous border, which is rounded. Operculum, interoperculum, and suboperculum very thin and similarly striated, the latter with a broad smooth membranous border. Six branchiostegals. Four gill-arches, a slit behind the last; gill-rakers few and stout, 12 on the first gill-arch, and provided with stout spines on the inner surface of their free portion. A single irregular row of cardiform teeth on the inner edge of the premaxillary; they are directed horizontally backward. Mandible with two short rows of similar teeth on each side of symphysis. Three acute teeth are arranged in a row on a median process of the vomer, and one or two on each palatine.

Dorsal fin originating a short distance behind tips of premaxillary processes. Five very short and fine rays precede the longer portion. These are followed by 130 simple rays, after which the body is damaged. Though very imperfect, the anterior rays appear to increase in height backward as illustrated in the figure, decreasing again towards the end of the tail, though those remaining indicate that they are well developed to the last. The pectoral is formed of fourteen simple rays, the outer two of which are very short; the median ones are longest. Two tubercles in pits in the skin just behind the vertical of the posterior angle of the pectoral base represent the remains of the ventrals.

Colour.—Apparently uniformly silver with a sharply defined black stripe along the upper surface of the head. Symphyses of both jaws black. After having been rubbed about in the sand, the tubercles covering the body are pure white. Fins pink when fresh.

Described and figured from a specimen, 1925 mm. long (approx.), from Middle Harbour, Port Jackson. It appears a little deeper than the holotype, to which it is exactly similar in every other detail. This specimen was observed swimming in shallow water by Mr. C. L. Scott, who succeeded in casting a line round it and hooking it in the eye. It swam with an undulating motion, and leapt out of the water when hooked. It was in perfect condition when captured, but was unfortunately much damaged before being forwarded to the Australian Museum.

Family SERRANIDAE.

ELLERKELDIA, *gen. nov.*

This name is proposed for the Australian fish *Gilbertia annulata* (Günther), originally described as a *Plectropoma* (Cat. Fish. Brit. Mus., i, 1859, p. 158). The name *Gilbertia* Jordan & Eigenmann (Bull. U.S. Fish. Comm. viii, (1888) 1891, p. 346. *Ex* Jordan MS.) was first published on 25th March, 1891, as the following extract from a letter to me from the Commissioner of Fisheries at Washington, U.S.A., states: "The date of issuance as a separate pamphlet of the Bureau's Document No. 144, entitled 'A Review of the Genera and Species of Serranidæ Found in the Waters of America and Europe,' by David Starr Jordan and Carl H. Eigenmann, comprising pages 329 to 441 of Bulletin of the U.S. Fish Commission, Volume viii, 1888, was March 25, 1891." *Gilbertia* Jordan & Eigenmann 1891 is thus clearly preoccupied by *Gilbertia* Cossmann (Ann. Soc. Roy. Malac. Belg., xxiv, 1889, before April 1890, p. 347), a genus of Mollusca, and *Ellerkeldia* should be used in its stead.

Orthotype.—Ellerkeldia annulata (Günther).

Family CARANGIDAE.

MEGALASPIS *Bleeker.*

Megalaspis Bleeker, Nat. Tijd. Ned. Ind., ii, 1851, p. 213. Orthotype, *Caranx rotleri* Cuvier & Valenciennes = *Megalaspis cordyla* (Linnaeus). Monotypic, not *Megalaspis* Angelin 1852, a genus of trilobites.

MEGALASPIS CORDYLA (*Linnaeus*).

(Plate xxiv, fig. 2.)

Scomber cordyla Linnaeus, Syst. Nat. Ed. 10, 1758, p. 298 (description only, not synonymy). No locality; I designate "East Indies" ("America" refers to the quoted works).

Scomber rottleri Bloch, Nat. ausl. Fische, vii, 1793, p. 88 (*fide* Sherborn), and Ichtyologie, x, 1797, pp. 39 & 74, pl. cccxlvi. Coromandel. *Id.*, Bloch & Schneider, Syst. Ichth., 1801, p. 25. *Id.*, Shaw, Gen. Zool., iv, 2, 1803, p. 598.

"*Woragoo*" Russell, Fish. Vizagapatam, ii, 1803, p. 33, pl. cxliii.

Caranx rottleri Rüppell, Atl. Reise Nordl. Afrika 1830-31, p. 102. *Id.*, Cantor, Cat. Malay. Fish. 1850, p. 124. *Id.*, Günther, Cat. Fish Brit. Mus., ii, 1860, p. 424. *Id.*, Kner, Reise "Novara," Fische, 1865, p. 150. *Id.*, Day, Fish. Malabar, 1865, p. 80. *Id.*, Day, Fish. India, i, 1878, p. 213.

Caranx rotleri Cuvier & Valenciennes, Hist. Nat. Poiss., ix, 1833, p. 29. *Id.*, Rüppell, Neue Wirbelth., Fische, 1835, pp. 48 & 52.

Megalaspis rottleri Bleeker, Nat. Tijd. Ned. Ind., ii, 1851, p. 213.

Megalaspis cordyla Jordan & Seale, Bull. U.S. Fish. Bur. xxv, 1906, p. 229. *Id.*, McCulloch, Biol. Res. "Endeavour," iii, 3, 1915, p. 139. *Id.*, Wakiya, Ann. Carn. Mus., xv, 1924, p. 147, pl. xv, fig. 1.

A specimen of this species, shown in the accompanying figure, was caught at La Perouse, Botany Bay, and is the first to be recorded from New South Wales. When fresh, its colours were as follows.

Silvery on the cheeks, maxilla, and lower jaw, above which the colour

is dark blue suffused with dark green lustre. Lower lip dark. Orbit encircled with pearly grey, tinged here and there with copper. Adipose eyelid hyaline. A black blotch over the operculum. A small faint green mark begins behind posterior edge of maxilla and stretches in an ill-defined crescent, with horns pointing upwards, to the opercular blotch.

Body silvery on sides, darker above, similar to head. Lateral scutes silvery. Scales above them dark blue-grey with greenish lustre; those below them silvery, reflecting iridescent pinks and blues in places.

First dorsal almost transparent; spines smoky grey, blacker at tips. Second dorsal yellow, rays dark-tipped; finlets yellow. Upper pectoral rays yellow, lower white; inner axil dark grey. Ventrals and anal spines, rays and finlets white. Caudal yellow with a dark grey border.

D.i, vii, i/9+9; A.ii, i/8+8; P. 21; V.i/5; C. 16. L. lat. 53.

The species is uncommon in Australia. The F.I.S. "Endeavour" trawled it off Bowen, Queensland. Specimens are in the Australian Museum from Manila, P.I. (Seale); Madras, India (Day).

Mr. David G. Stead, while Special Fisheries Commissioner and Director of Food Supplies to the Governments of the Straits Settlements, the Federated Malay States, and the Malay States not included in the Federation, made a large collection of fishes, now in the Australian Museum.

Megalaspis cordyla is represented therein by specimens from the following localities:—

Bandar Maharani (= Muar)	16 December, 1922.
Singgora, Siam	6 May, 1922.
Kuala Kurau	27 December, 1922.
Trengganu	1 May, 1922.
Malacca	25 October, 1922.
Cape Rachado	18 February, 1922.

A small specimen, gutted and dried, but with the head on, is labelled "No. 264. 1 *Caranx* sp., as dried at Besi Api, Kuala Dungun, 28/11/22."

Synonymy.—*Megalaspis cordyla* is readily recognisable by the numerous finlets behind its dorsal and anal fins. Linnaeus mentions them in his description of *Scomber cordyla*, but includes references to an American fish, "*Trachurus brasiliensis* Ray," which is a distinct species now called *Caranx cordylaoides* Meuschen (*infra*). Numerous authors have copied Linnaeus in mixing the American species without finlets (*Caranx*) with *cordyla*, but I am of the opinion that Linnaeus' name should be used for the finletted *Megalaspis cordyla* because he first gave an accurate description of it. His synonymy referring to the American fish should be transferred to that of *Caranx cordylaoides*.

Scomber rottleri Bloch has been much used for *Megalaspis cordyla*, because of the Linnean confusion, but is a synonym of it.

CARANX *Lacépède* 1802, *subgenus* USA, *nov.*

Selenia Bonaparte, Cat. Metod. 1843, p. 75. Type, *Caranx luna* St. Hilaire=*Scomber guara* Bonnaterre [=*Caranx* (*Usa*) *cordylaoides* Meuschen] (*fide* Jordan & Jordan, Mem. Carneg. Mus., x, 1, 1922, p.

40). Preoccupied by *Selenia* Hübner, 1816, a genus of Lepidoptera (*fide* Agassiz, Nomencl. Zool.).

Longirostrum Wakiya, Ann. Carneg. Mus., xv, 1924, pp. 164 & 202. Substitute for *Selenia*, preoccupied; but itself preoccupied by *Longirostris* S.D.W. 1836, a genus of birds.

I am obliged to Mr. T. Iredale for calling my attention to *Longirostris*, a name proposed by S.D.W[ood], Analyst, iv, 1836, p. 119, for an avian genus. Wood's name preoccupies *Longirostrum* recently proposed by Wakiya (*loc. cit.*) for *Selenia* (preocc.). I accordingly propose the new subgeneric name *Usa* as a substitute, with the American *Caranx* (*Usa*) *cordylaoides* Meuschen as orthotype.

CARANX (USA) CORDYLAOIDES (*Meuschen*).

" *Guara terebra* " Marcgrave, Hist. Brasil, 1648, p. 172 (*fide* Lacépède, Hist. Nat. Poiss., ii, 1800, p. 604, footnote). Brazil.

" *Trachurus brasiliensis* " Ray, Synops. meth. avium pisc., 1710, p. 93. Brazil.

" *Scomber linea laterali curva*," &c. Gronovius, Act. Upsala, 1744 or 1750, p. 36; Mus. Ichth. i, 1754, p. 34, No. 82; and Zoophyl., i, 1763, p. 94, No. 307 (*fide* Cuvier & Valenciennes, Hist. Nat. Poiss., ix, 1833, p. 32, footnote). No locality=America.

Scomber cordyla Linnaeus, Syst. Nat. ed. 10, 1758, p. 298; and ed. 12, 1766, p. 493 (synonymy only). *Id.*, Gmelin, *ibid.*, ed. 13, i, 3, 1789, p. 1332. *Id.*, Bloch & Schneider, Syst. Ichth., 1801, p. 23. Not *Scomber cordyla* Linnaeus 1758, descriptive part=*Megalaspis cordyla* (Linn.). America.

Scomber cordylaoides Meuschen, Index Zoophyl. Gronov., pt. iii, 1781. Based on Gronovius, Zoophyl., No. 307. (*supra*).

Scomber cordila Bonnaterre, Tabl. Encycl. Meth. Ichth., 1788, p. 139, pl. lviii, fig. 229 (" Le Guare.") [Not part describing finlets, which applies to *Megalaspis cordyla* (Linnaeus).] Based on Seba, iii, 1758, pl. 27, fig. 3 (*fide* Cuvier & Valenciennes, Hist. Nat. Poiss. ix, 1833, p. 33, footnote). America.

Scomber guara Lacépède, Hist. Nat. Poiss., ii, 1800, pp. 598 & 604. [Not part describing finlets, which applies to *Megalaspis cordyla* (Linnaeus).] South America.

Scomber dentex Bloch & Schneider, Syst. Ichth., 1801, p. 30. Brazil.

Caranx luna Geoffroy St. Hilaire, Descr. Egypt. Poiss., 1809, pl. xxiii. (*fide* Jordan & Gilbert, Proc. U.S. Nat. Mus., vi, 1884, p. 197 and Jordan & Jordan, Mem. Carneg. Mus., x, 1, 1922, p. 40). Red Sea, Egypt. *Id.*, Cuvier & Valenciennes, Hist. Nat. Poiss., ix, 1833, p. 80.

Trachurus cordyla Gray, Cat. Fish. coll. Gronow Brit. Mus., 1854, p. 124. *Ex* Gronovius.

Caranx (*Uraspis*) *guara* Jordan & Evermann, Bull. U.S. Nat. Mus., xlvii, 1, 1896, p. 926. "Habitat in Pelagico inter Tropicos."

Synonymy.—The American *Caranx* (*Usa*) *cordylaoides* has been confused in literature with the Indo-Australian *Megalaspis cordyla* (*q.v.*, *supra*); the finlets of *Megalaspis*, however, readily distinguish it from the American fish. The latter has received many names as set forth in the above synonymy. It was wrongly appended to the description of

Scomber [=*Megalaspis*] *cordyla* given by Linnaeus (1758), whose mistake has been copied by later authors. Gronovius' remarks and unqueried references in his Zoophylacium (1763) refer to the American fish, but his name is non-binomial. Meuschen (1781) remedied this deficiency by naming Gronovius' species *Scomber cordylaoides*, and his specific name, hitherto apparently overlooked, must be used in preference to later ones. Bonnaterre figured this species, which he called "Le Guare" (*Scomber cordila*), but included in his description the finlets appertaining to *Megalaspis*, and Lacépède based his name *Scomber guara* on the same species. *Scomber dentex* and *Caranx luna* appear, on good authority, to be synonyms also of *Caranx* (*Usa*) *cordylaoides*.

Family SCORPIDAE.

SCORPIS LINEOLATUS *Kner*.

(Pl. xxv, fig. 1.)

Scorpis lineolatus Kner, Reise "Novara" Zool., i, Fische, pt. i, 1865, p. 108, pl. v, fig. 3, Sydney. *Id.*, McCulloch, Rec. Austr. Mus., xi, 7, 1917, p. 178 (references and synonymy).

A young specimen, 102 mm. long from the snout to the end of the middle caudal rays, figured here, has D.x/26; A.iii/26.

Loc.—Coogee Beach, New South Wales; coll. G. P. Whitley, March 2nd, 1924.

Family POMACENTRIDÆ.

POMACENTRUS WARDI, *sp. nov.*

(Fig. 1.)

D.xiii/15; A.ii/15; P. 19; V.i/5; C. 15. Sc. 26. 19 tubes on 1. lat. plus about 7 punctured scales.

Head (19 mm.) 3.2 in length to hypural joint (60); depth, including scaly dorsal sheath (32) 1.8 in same. Snout (4) 1.5 in interorbital width (6), which is less than eye (6.5). Narrowest depth of caudal peduncle (8) one-tenth of total length (80).

Head scaly except in advance of the nostrils, on the preorbital and on the throat. A row of pores along the narrow, strongly but irregularly serrated, suborbital. Other opercles entire except the upper limb of the preoperculum which is strongly denticulated. A minute opercular spine. Eye large. Interorbital convex. Maxillary not reaching vertical of anterior margin of the eye. A single series of compressed incisors in each jaw, extending along a descending lateral ramus in the upper jaw and along a similar ascending one in the lower. Gill-rakers slender; long above, very short below.

Body deep, compressed, covered with ctenoid scales, which extend over the bases of all the fins and between the spines and rays, excepting the ventrals. Long axillary scales on each side of the ventrals, and a large rounded scale with a concave inferior margin over the shoulder girdle just above the pectoral fin. Lateral line curved, originating above the operculum, where there is a modified toothed scale, and terminating beneath the soft dorsal. A few punctured scales on each side of the tail.

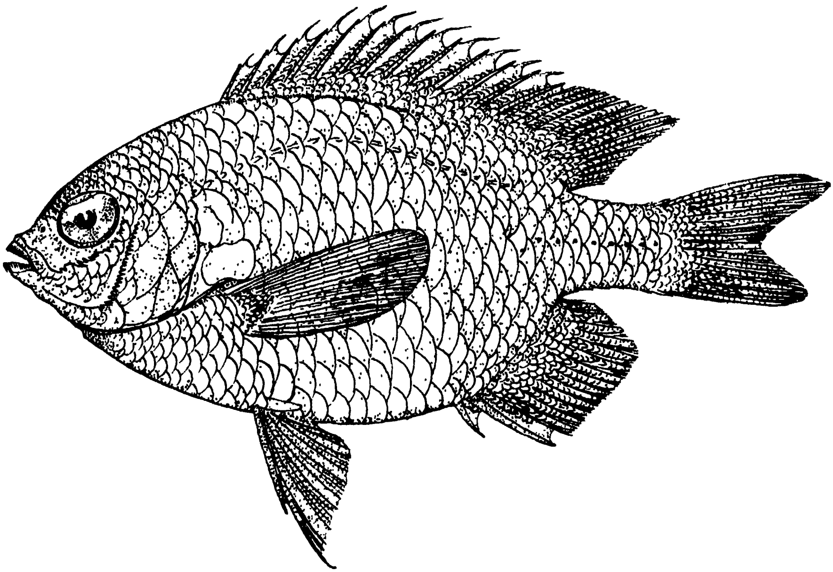
Dorsal originating in advance of the vertical of the pectoral origin

and terminating slightly behind the anal. Fins moderately pointed; caudal forked, the upper lobe longer.

Colour, in alcohol, brownish, darker on the dorsal, ventral, and anal, becoming olivaceous on the sides and breast, and to a lesser extent on the tail and pectorals; the two shades merging one into the other. Some scales with a fuscous crescentic bar.

Described and figured from the holotype, 80 mm. long, from Heron Island, Capricorn Group, Great Barrier Reef, Queensland; collected by Mr. Melbourne Ward. Australian Museum Registered No. IA.2964.

A paratype was caught with the holotype and agrees with it in detail. It has, however, a few whitish flecks on the opercular scales, whereas the holotype is plain.



Pomacentrus wardi Whitley sp. nov. Holotype, 80 mm. long, from Heron Island, Capricorn Group, Great Barrier Reef, Queensland.
G. P. WHITLEY del.

Pomacentrus wardi is near, if not identical with, *P. trilineatus* as figured by Bleeker,[12] but differs from the original description given by Cuvier & Valenciennes[13] in lacking the elaborate pattern of their four-inch specimen. The type locality of *P. trilineatus* is the Red Sea.

Two other specimens of *Pomacentrus wardi* have D.xiii-xiv/14-16, and 16 anal rays. One was collected by Dr. W. E. J. Paradice of H.M.A.S. "Geranium" at Cape Wessell, Arnheim Land, Northern Territory of Australia; the other by Dr. Lockwood of H.M.A.S. "Moresby" from the Hervey Bay District, southern Queensland.

[12]Bleeker—Atl. Ichth., ix, 1877, pl. ccccvi, fig. 5.
[13]Cuvier and Valenciennes—Hist. Nat. Poiss., v, 1830, p. 428.

Three more, collected at High Island, McCulloch Reef, and Gibson Reef, North Queensland, by Dr. Paradice, agree with the types in their fin formulae, but have a small dark opercular spot.

DAYA JERDONI (*Day*).

Pomacentrus jerdoni Day, Proc. Zool. Soc., 1873, p. 237. Madras.

Pomacentrus dolii Macleay, Proc. Linn. Soc. N.S. Wales, vi, 1881, p. 65, pl. i, fig. 1. Port Jackson. Co-types in the Macleay Museum, University of Sydney.

Daya jerdoni McCulloch, Mem. Qld. Mus., vii, 3, 1921, p. 170, pl. ix, fig. 1.

Chromis virescens Ogilby, Mem. Qld. Mus., vii, 4, 1922, p. 303, pl. xix, fig. 3. Hervey Bay, south Queensland. Holotype in Queensland Museum.

I have examined the holotype of *Chromis virescens* Ogilby in the Queensland Museum (Regd. No. I.3477) and find that it agrees in detail with specimens identified by McCulloch as *Daya jerdoni* Day in the same institution. The head of Ogilby's type has been distorted in preservation, which accounts for the discrepancies in proportions between his description and that given by McCulloch. The hinder border of the preoperculum and the rounded angle of the operculum are distinctly, though minutely, serrated, and there are two opercular spines. The dentition is that of *Daya jerdoni*. The lower part of the first gill-arch has been removed from one side of the holotype.

Family GOBIIDAE.

TRYPAUCHEN VAGINA (*Bloch & Schneider*).

Gobius vagina Bloch & Schneider, Syst. Ichth., 1801, p. 73. Tranquebar.

Trypauchen vagina Day, Fish. India, i, 1876, p. 320, pl. lxviii, fig. 2.

A specimen from Bowen in the Queensland Museum agrees excellently with Day's figure. New record for Australia.

Family TETRAODONTIDAE.

TETRAODON STELLATUS *Bloch & Schneider*.

Tetrodon lagocephalus var. *stellatus* Bloch & Schneider, Syst. Ichth., 1801, p. 503. Seas around Mauritius.

Tetraodon stellatus Day, Fish. India, i, 1878, p. 705, pl. clxxxiii, fig. 3.

Tetrodon stellatus Günther, Fische Südsee, ix, 1910, p. 465, pl. clxvi, fig. B.

A large specimen in the Queensland Museum from Townsville (Regd. No. I.4269) admits this species into the Queensland fish-fauna, as a member of which it has not hitherto been recognised.

Family CHEIMARRICHTHYIDAE.

CHEIMARRICHTHYS *Haast*.

Cheimarrichthys Haast, Trans. N.Z. Inst., vi, June, 1874, p. 103. Haplotype, *Cheimarrichthys fosteri* Haast, *loc. cit.* Not *Chimarrichthys* Sauvage 1874.

Note on priority.—Haast's name, published in June, 1874, takes precedence over *Chimarrichthys* Sauvage (Revue et Mag. Zool. (3) ii, after June, 1874, p. 332) which was proposed for a Thibetan catfish, *C. davidi* Sauvage.

Sauvage's genus and species was recently redescribed by Norman (Ann. Mag. Nat. Hist. (9) xv, 1925, p. 570) as *Euchiloglanis davidi*.

Family SCORPAENIDAE.

ABCICHTHYS *gen. nov.*

Liocranium Ogilby, Proc. Roy. Soc. Qld., xviii, 1904, p. 23. Orthotype *Liocranium praepositum* Ogilby, *loc. cit.* *Id.*, McCulloch, Biol. Res. Endeavour, iv, 4, 1916, p. 195. Not *Liocranum* Koch, 1866, a genus of Arachnida.

Liocranium Ogilby 1904, appears to be preoccupied by *Liocranum* Koch (Die Arach.-Fam. der Drassiden, 1866, p. 366), so I have re-named it *Abcichthys*, with *A. praepositus* (Ogilby) as orthotype.

Family SALARIIDAE.

SALARIAS GEMINATUS *Alleyne & Macleay.*

Salarias geminatus Alleyne & Macleay, Proc. Linn. Soc. N.S. Wales, i, March 1877, p. 336, pl. xiii, fig. 3. Torres Strait. *Id.*, McCulloch & McNeill, Rec. Austr. Mus., xii, 2, 1918, p. 20.

Salarias cristiceps Alleyne & Macleay, Proc. Linn. Soc. N.S. Wales, i, March 1877, p. 338, pl. xiv, fig. 3. Darnley Island.

The range of this species, hitherto known only from Murray and Darnley Islands, Torres Strait, Queensland, may now be extended to include New Caledonia, as Mr. A. F. Basset Hull collected a specimen there.

D.xii/23; A.ii/24. Dorsal incised, connected to caudal peduncle; posterior anal ray not thus connected. Ocular tentacle branched. Regd. No. IA.2955.

Family GOBIESOCIDAE.

DIPLOCREPIS COSTATUS *Ogilby.*

Diplocrepis costatus Ogilby, Proc. Linn. Soc. N.S. Wales, x, 2, 1885, p. 270. Port Jackson. *Id.*, Waite, Rec. Austr. Mus., v, 3, 1904, p. 179, pl. xxiv, fig. 1. *Id.*, Waite, *Op. cit.*, vi, 3, 1906, p. 203. *Id.*, McCulloch & Waite, Rec. S. Austr. Mus., i, 1, 1918, p. 66.

This species has been recorded from South Australia, Victoria, New South Wales and Lord Howe Island. Mr. A. F. Basset Hull recently collected specimens at New Caledonia, from which locality it has not hitherto been recorded. I have compared his specimens with the types, and find they are not even separable from *D. costatus* as varieties. They have the following characters:—D. 9-10; A. 8. General colour in spirits dull yellowish. A dusky ill-defined cross-band across the nape, another over the pectorals, a third between the tips of the pectorals and the origin of the dorsal, and traces of another between dorsal and anal. Top of head dusky; interorbital lighter. Vertical fins with minute punctulations, with lighter interspaces distally. One specimen has several irregularly disposed wart-like growths, mostly on the right side. Austr. Mus. Regd. No. IA.2953.

NEW AUSTRALIAN MEMBRACIDAE (HOMOPTERA).

BY

W. D. FUNKHOUSER, University of Kentucky, Lexington, Ky., United States of America.

(Pl. xxvi.)

Through the courtesy of the Trustees of the Australian Museum the writer has had the privilege of studying a small collection of Membracidae from Australia and the neighbouring islands with the result that the following new species may be described.

EMPHUSIS BICORNIS, *sp. nov.*

(Pl. xxvi, figs. 1-2.)

Near *E. bakeri* Funkh. but differing particularly in the shape and position of the pronotal horns.

Large, rough, purplish-brown with yellowish pubescence; pronotum high and bearing at its summit a pair of horns which extend outward and curve downward; posterior process decurved and extending almost to apices of tegmina; tegmina purplish-brown with base narrowly punctate; undersurface brown with sides of thorax densely tomentose.

Head about as wide as long, very dark brown, finely punctate, sparingly pilose, roughly sculptured; base regularly arcuate; eyes large, brown; ocelli large, white, about equidistant from each other and from the eyes and situated on a line drawn through centres of eyes; clypeus twice as long as wide, extending for more than half its length below inferior margins of genae, tip acute and pubescent.

Pronotum purplish-brown; roughly punctate, sparingly pubescent; metopidium twice as high as broad, arising straight above the head; humeral angles large, prominent, acute; suprahumeral horns arising from top of metopidium, extending outward and curving downward, flattened dorso-ventrally, irregularly ridged above, tips sharp; median carina percurrent; a sordid yellow tomentose line on each side extending from front base of horn to behind eye and another from posterior base of horn to scutellum; scutellum narrowly exposed; posterior process long, slender, decurved, impinging on tegmina, tricarinate, tip sharp and extending almost to apices of tegmina.

Tegmina long, narrow, purplish-brown; base narrowly darker and punctate; veins prominent; five apical and two discoidal cells.

Undersurface, abdomen, and legs entirely brown; sides of thorax densely tomentose.

Length from front of head to tips of tegmina 10 mm.; 'width between tips of suprahumeral horns 9 mm.

Type.—Male.

Type locality.—Elenagora, British New Guinea.

Collector.—Dr. E. O. Pockley.

Described from one male and one female, the male labelled " Elenagora, Brit. N. Guinea. 18.10.'21. E. O. Pockley " and the female labelled " Koitaki, Brit. N. Guinea. 5-12. 5.'21. E. O. Pockley." Type and allotype in Australian Museum collection.

CENTROTYPUS NIGRIS, *sp. nov.*

(Pl. xxvi, figs. 3-4.)

Small, black, punctate, pubescent; eyes white with brown centers; suprahumeral horns short, broad, flat, extending outward and slightly upward; posterior process short, tectiform, reaching just to internal angles of tegmina; tegmina smoky-hyaline; sides of thorax pilose; undersurface and legs black.

Head subquadrate, convex, broader than long, black, finely punctate, sparingly pubescent; base sinuate; eyes white with brown centers; ocelli white, glassy, about equidistant from each other and from the eyes and situated somewhat above a line drawn through centres of eyes; clypeus longer than broad, deflexed, extending for more than half its length below inferior margins of genae, tip truncate and pilose.

Pronotum black, finely punctate, sparsely pubescent; metopidium broader than high, slightly convex; median carina strongly percurrent; humeral angles small, blunt, closer to the horns than to the eyes; suprahumeral horns short, not as long as the distance between their bases, flattened dorso-ventrally, extending outward and upward, anterior margin curved, posterior margin straight, tip acute; posterior process short, heavy, tectiform, tip sharp and reaching just to internal angles of tegmina; scutellum well exposed, about as broad as long.

Tegmina smoky-hyaline; base black, opaque and punctate; veins prominent, brown, spiny; apical limbus narrow; five apical and two discoidal cells.

Sides of thorax tomentose; undersurface, abdomen, and legs black.

Length from front of head to tips of tegmina 5.5 mm.; width between tips of suprahumeral horns 3.2 mm.

Type.—Female.

Type locality.—Broken Hill, New South Wales.

Collector.—F. W. Shepherd.

Described from a single specimen. Type in Australian Museum collection.

EUFAIRMAIRIA LATICORNIS, *sp. nov.*

(Pl. xxvi, figs. 5-6.)

Dark brown, punctate, pubescent; suprahumeral horns broad, flat extending almost directly outward; posterior process long, slender, decurved, reaching almost to tips of tegmina; tegmina fuscous-hyaline, base and costal margin punctate; undersurface and legs brown.

Head subquadrate, broader than long, brown, punctate, densely pubescent; eyes large, brown; ocelli large, white, a little farther from each other than from the eyes and situated above a line drawn through centers of eyes; clypeus trilobate, longer than broad, deflexed, tip acute and pubescent.

Pronotum brown, roughly punctate, sparingly pubescent; metopidium nearly twice as high as broad, a smooth black spot over each eye; humeral angles large, prominent, blunt, much nearer to the eyes than to the horns; median carina strongly percurrent; suprahumeral horns long, flattened dorso-ventrally, more than twice as long as the distance between their bases, irregularly ridged above, extending almost directly outward, tips acuminate; posterior process heavy at base with a strong ridge on each side of median carina, posterior half slender, at first arcuate, then decurved, tip acuminate and reaching almost to tips of tegmina; scutellum narrowly exposed, tomentose.

Tegmina fuscous-hyaline; base and costal area reddish-brown, opaque and punctate; veins heavy, prominent, brown; tips clouded with reddish-brown.

Sides of thorax densely tomentose; undersurface, abdomen and legs uniformly brown.

Length from front of head to tips of tegmina 9 mm.; width between tips of suprahumeral horns 6.8 mm.

Type.—Male.

Type locality.—Fly River, Papua.

Described from a single specimen. Type in collection of Australian Museum.

LEPTOCENTRUS GRACILIS, *sp. nov.*

(Pl. xxvi, figs. 7-8.)

Long, slender, brown, punctate, pubescent; suprahumeral horns long, slender, extending outward and upward and curving backward; posterior process long, slender, elevated above tegmina; tegmina wrinkled hyaline; sides of thorax tomentose; undersurface, abdomen and legs brown.

Head subquadrate, wider than long, brown, punctate, pilose, roughly sculptured; base arcuate; eyes brown; ocelli large, white, sunken, somewhat farther from each other than from the eyes and situated slightly above a line drawn through centers of eyes; clypeus twice as long as

broad, densely pilose, extending for more than half its length below inferior margins of genae, tip narrow.

Pronotum brown, coarsely punctate, sparingly pilose; metopidium higher than wide, convex, polished, shining; humeral angles prominent, blunt, much nearer to the eyes than to the horns; median carina obsolete over metopidium but prominent behind the horns; suprahumeral horns long, slender, polished, tricarinate, extending upward and outward and curving backward, tips acuminate; scutellum entirely exposed, longer than broad, lightly tomentose, tip deeply notched; posterior process long, slender, deflexed, subarcuate, elevated above scutellum and tegmina, tip sharp, black, extending well beyond internal angles of tegmina, about to apex of abdomen.

Tegmina long, narrow, wrinkled, hyaline; base narrowly yellow, opaque and punctate; veins prominent, brown; faint brown cloud on internal apical margins; apical limbus narrow; five apical and two discoidal cells.

Sides of thorax white tomentose; undersurface, abdomen and legs entirely and uniformly brown.

Length from front of head to tips of tegmina 9 mm.; width between tips of suprahumeral horns 7 mm.

Type.—Female.

Type locality.—Broken Hill, New South Wales.

Collector.—F. W. Shepherd (1924).

Described from a single specimen. Type in Australian Museum collection.

TRICENTRUS PINGUIDORSIS, *sp. nov.*

(Pl. xxvi, figs. 9-10.)

Small, black, punctate, pubescent; suprahumeral horns small, triangular, extending outward and slightly upward; posterior process thick, heavy, short, swollen, somewhat arcuate; tegmina hyaline with base black; undersurface and legs black; hind trochanters armed with spines.

Head subquadrate, wider than long, black, finely punctate, densely pilose; base sinuate; eyes gray; ocelli small, prominent, white with black centres, equidistant from each other and from the eyes and situated on a line drawn through centres of eyes; clypeus longer than wide, extending for half its length below inferior margins of genae, tip truncate and pilose.

Pronotum black, finely punctate, densely pubescent; metopidium about as broad as high, straight above head; median carina faintly percurrent; humeral angles prominent, blunt, much nearer to the horns than to the eyes; suprahumeral horns small, triangular, blunt, as long as half the distance between their bases, tricarinate; posterior process short, heavy, swollen, dorsal line elevated in middle, tip blunt and extending just to internal angles of tegmina; scutellum broadly exposed.

Tegmina hyaline, somewhat smoky in apical region; base black, opaque and punctate; veins, heavy, brown and sparsely spined; five apical and two discoidal cells.

Sides of thorax pilose with long silvery hairs; undersurface, abdomen, and legs black; tarsi fuscous; hind trochanters bearing short spine-like teeth.

Length from front of head to tips of tegmina 4.5 mm.; width between tips of suprahumeral horns 2.7mm.

Type.—Male.

Type locality.—Broken Hill, New South Wales.

Collector.—F. W. Shepherd (1924).

Described from a single specimen. Type in Australian Museum collection.

OTINOTOIDES BRUNNEUS, *sp. nov.*

(Pl. xxvi, figs. 11-12.)

Uniformly dark brown, punctate, pubescent; suprahumeral horns extending directly outward; posterior process much decurved, reaching almost to tips of tegmina; tegmina brown and nearly opaque; sides of thorax brown tomentose; hind trochanters unarmed; clypeus strongly trilobate.

Head wider than long, roughly sculptured, dark brown, finely punctate, densely pubescent; base arcuate; eyes large, brown; ocelli large, prominent, brown, equidistant from each other and from the eyes and situated on a line drawn through centres of eyes; clypeus as wide as long, extending for about half its length below inferior margins of genae, tip strongly trilobate.

Pronotum dark brown, finely punctate, densely pubescent; metopidium about as high as broad, convex, an irregular black mark over each eye; median carina faintly percurrent; humeral angles large, prominent, blunt, a little closer to the horns than to the eyes; suprahumeral horns strong, heavy, tricarinate, about as long as the distance between their bases, extending directly outward, slightly curving backward, tips blunt; scutellum well exposed, tomentose; posterior process heavy at base with a faint ridge on each side of median line, apical two-thirds long, slender, much decurved, impinging on tegmina, tip sharp and reaching almost to apices of tegmina.

Tegmina mottled brown; basal and basal costal area dark brown, opaque and punctate; veins not prominent; apical limbus very narrow, five apical and three discoidal cells.

Sides of thorax ferruginous-brown tomentose; undersurface abdomen and bases of femora dark brown; apices of femora and all of tibiae and tarsi light brown.

Length from front of head to tips of tegmina 6.8 mm.; width between tips of suprahumeral horns 5 mm.

Type.—Female.

Type locality.—Lavoro Plantation, Guadalcanar Island, Solomon Group.

Collector.—Mr. C. E. Hart.

Described from two females, both labelled "Lavoro Pltn; Guadalcanar I., Solomon Group. C. E. Hart. 1925." Type and paratype in Australian Museum collection.

ACANTHUCUS PYRAMIDATUS, *sp. nov.*

(Pl. xxvi, figs. 13-14.)

Large, yellow-brown, punctate, pubescent; suprahumeral horns heavy, extending outward and upward and curving laterad; dorsal crest high, triangular, blunt; posterior process tectiform, extending to a point half-way between internal angles and tips of tegmina; tegmina wrinkled hyaline, base brown and punctate; sides of thorax white tomentose; undersurface and legs yellow-brown.

Head as broad as long, brown mottled with black, roughly sculptured, densely pilose; base irregularly arcuate; eyes large, yellow; ocelli large, reddish brown, elevated, farther from each other than from the eyes and situated slightly above a line drawn through centres of eyes; clypeus longer than wide, lightly trilobate, extending for more than half its length below inferior margins of genae.

Pronotum yellow-brown, darker in front than behind, coarsely punctate, densely pilose with long white hairs; metopidiun about as broad as high, sloping above head, darker at base, a smooth brown spot above each eye; humeral angles large, prominent, blunt, extending outward farther than the eyes; median carina strongly percurrent; suprahumeral horns thick, heavy, blunt, about as long as the distance between their bases, extending outward and upward and curving laterad; tricarinate, roughly punctured; dorsal crest arising from behind the horns, large, triangular, heavy, blunt, anterior half darker than posterior; scutellum well exposed, white tomentose; posterior process tectiform, gradually acute, tip reaching to a point about halfway between internal angles and tips of tegmina.

Tegmina wrinkled hyaline; base brown, opaque and punctate; veins prominent, yellow-brown and pilose; apical limbus narrow; five apical and two discoidal cells.

Sides of thorax densely white tomentose; undersurface and abdomen brown; legs reddish-brown; tarsi very dark brown.

Length from front of head to tips of tegmina 7 mm.; width between tips of suprahumeral horns 4 mm.

Type.—Female.

Type locality—Wedge Bay, Tasmania.

Collector—G. H. Hardy.

Described from two females both collected by G. H. Hardy, the type from Wedge Bay, December 30, 1913 and the paratype from Hobart, March 25, 1916. Both specimens in Australian Museum collection.

ACANTHUCUS CARINATUS, *sp. nov.*

(Pl. xxvi, fig. 15.)

Greenish-brown, rugose, punctate, not pubescent; suprahumeral horns tricarinate, acute, extending outward, upward, and forward; median dorsal carina foliaceous, not projecting in a horn; posterior process decurved, reaching almost to apices of tegmina; tegmina yellowish-hyaline; undersurface and abdomen brown; legs yellow-brown.

Head broader than long, convex, roughly sculptured, very finely punctate, not pubescent, reddish yellow except median area which is dark brown; base arcuate and feebly sinuate; eyes yellow-brown; ocelli large, prominent, yellow with black borders, about equidistant from each other and from the eyes and situated above a line drawn through centres of eyes; clypeus longer than wide, trilobate, extending for about half its length below inferior margins of genae.

Pronotum yellow-brown, coarsely punctate, not pubescent; metopidium broader than high, a black spot on median line; humeral angles blunt, prominent, a little nearer to the eyes than to the horns and extending laterad slightly beyond the eyes; median carina strongly percurrent, foliaceous behind the horns and on the posterior process; suprahumeral horns stout, tricarinate, sharp, extending outward, upward and slightly forward; scutellum narrowly exposed; posterior process long, sinuate, tectiform, base thick, apical portion slender, tip acuminate and extending almost to apices of tegmina.

Tegmina yellowish-hyaline, wrinkled; base and basal costal margin yellow, opaque and punctate; veins light yellow, inconspicuous; apical limbus narrow; five apical and two discoidal cells; third apical cell slightly curved.

Sides of thorax yellow; undersurface and abdomen brown; legs yellow-brown.

Length from front of head to tips of tegmina 5.4 mm.; width between tips of suprahumeral horns 3 mm.

Type.—Male.

Type locality.—South Australia.

Described from two specimens, a male and a female, both with the same locality label and both bearing the Australian Museum collection number "K 53627." Type and allotype in the collection of the Australian Museum.

SEXTIUS PROJECTUS, *sp. nov.*

(Pl. xxvi, fig. 16.)

Brown, punctate, pubescent; suprahumeral horns projecting forward; posterior process reaching to tips of tegmina; tegmina milky-hyaline with brown veins and many small cells in apical area; sides of thorax white tomentose; undersurface and legs brown.

Head a little broader than long, black, finely punctate, densely pubescent with short, heavy, white hairs; base arcuate; eyes large, gray; ocelli small, gray, inconspicuous, farther from each other than from the eyes and situated above a line drawn through centres of eyes; clypeus longer than wide, weakly trilobed, extending for more than half its length below inferior margins of genae, tip rounded.

Pronotum brown, coarsely punctate, sparsely pubescent with short, thick, white hairs; metopidium wider than high; humeral angles prominent, blunt; median carina black, strongly percurrent; suprahumeral horns heavy, thick, truncate at tips, flattened laterally, arising close together near head and extending outward, upward, and strongly forward, internal and external sides deeply ridged; posterior process long, strong, impinging on tegmina, tectiform, gradually decurved, tip reaching just to apices of tegmina; scutellum narrowly exposed.

Tegmina long, narrow, milky-hyaline, translucent; base and basal costal area brown, opaque and punctate; veins prominent, brown; apical limbus very narrow; apical area broken up into many small cells.

Sides of thorax white tomentose; undersurface, abdomen and legs uniformly and entirely brown; tibiae somewhat foliaceous.

Length from front of head to tips of tegmina 6 mm.; width between tips of suprahumeral horns 3 mm.

Type.—Female.

Type locality.—King George's Sound, Western Australia.

Described from a single specimen now in the collection of the Australian Museum.

MINERALOGICAL NOTES No. 3.*

By

T. Hodge Smith,

Mineralogist and Petrologist, the Australian Museum.

(Plates xxvii-xxx.)

Calcite.

Garibaldi Mine, Lionsville, New South Wales.

(Plates xxvii, figs. 1-4, xxviii, xxix, fig. 1 and xxx.)

Some forty specimens of well crystallised calcite were collected by Mr. D. A. Porter in July, 1916, from the Garibaldi (Gold) Mine near Lionsville, about five miles west of the Upper Clarence River, Parish of Churchill, County of Drake, New South Wales. The mine is situated in very rugged country on the side of a spur about 730 feet above the Lionsville post office and about a quarter mile to the west.

According to Mr. Porter, the men were driving a tunnel and had driven about 150 to 200 feet when they noticed that one of the walls sounded quite hollow. They put in a charge of explosive and exposed a cavern with a cubic content of about 1200 cubic feet, but containing no calcite crystals of any note. The floor of the cavern was level with the floor of the tunnel and on the far side was a deep natural well about six feet in diameter, filled with clear water, the walls probably covered with calcite crystals. Beyond the well is a bar of rock rising up diagonally, and about two feet above the floor is a small opening leading into another chamber slightly larger than the first and completely lined with calcite crystals.

The largest single crystal collected by Mr. Porter measures approximately 33 cm. × 30 cm. × 28 cm., although very much larger crystals do occur, as I have seen one weighing several hundredweight. Some of the smaller crystals are quite transparent, but the majority become more or less cloudy toward the centre.

There appears to be no reference to the geology of the mine that will help to throw any light on the origin of the cave or the calcite. Mr. Porter reported that he was unable to find any limestone in or around the mine. Only two specimens in the collection contained matrix. In one the calcite is deposited on quartz containing minute dodecahedral and cubic crystals

*For No. 2, see "Records of the Australian Museum," vol. xv, no. 1, 1926, p. 69.

of pyrite disseminated fairly abundantly throughout. The matrix of the other specimen consists of a soft clayey material varying in colour from greenish-grey to almost black.

In view of the lack of any definite information on these points, I visited the mine in December, 1925, accompanied by my colleague Mr. C. M. G. Friend. Unfortunately most of the calcite crystals had been removed and many fine crystals broken up in the search for Iceland spar suitable for optical purposes. However these mining operations greatly facilitated the study of the structure of the cave. It was at once obvious that the cave had formed along an almost vertical fault plane cutting across the Garibaldi lode. The fault plane is indicated by a narrow fault breccia and the presence of much slickensiding. In the cave the rock on both sides of the fault plane appears to be identical. It is a very much altered felspar porphyry. Under the microscope the phenocrysts of felspar are seen to have been completely altered in many cases to saussurite and the ground mass consists of a fine grained complex of chlorite, calcite, and completely altered minute felspar laths.

An examination of the ore channel material of the Garibaldi Mine reveals the fact that it consists mainly of much decomposed country rock with quartz, calcite, and a little pyrite. The gold is not evenly distributed but is found in patches. The association of quartz and calcite is perhaps the most common to be found in veinstones, and in the numerous veins that occur in the district it is quite characteristic. A careful search was made for the presence of limestone in the vicinity of the cave, and for a radius of three-quarter mile at least, nothing but igneous rocks was found. The country is extremely rugged and covered with a semi-tropical vegetation rendering an examination somewhat difficult. The evidence of the boulders and pebbles found in the creeks draining the area failed to reveal the presence of limestone. In a private communication from Dr. W. F. Straubel, manager of this mine, received since my return, he informs me that marble has been reported about eight miles north east of Lionsville. It is extremely doubtful whether this marble bears any relation to the calcite under review.

The Garibaldi lode has not been displaced by the fault plane along which the cave has formed, so that it is evident that the fault plane is the older. It is very probable that the original cave was formed by a buckling of the rock along the fault plane at the time of its formation, and is therefore older than the lode. Although the cave is separated from the lode by country rock, the gold-bearing solutions must have penetrated the cave and there deposited both quartz and calcite. The fact that the country rock has been affected by these solutions for a considerable distance from the ore channel, and that a specimen of calcite with quartz and pyrite has been found in the cave, lends support to this view.

The roof of the cave has fallen and the original floor of the cave may be many feet below the present floor. It is certainly at least ten feet

below. The falling in of the roof appears to have been subsequent to the formation of the lode, as I was unable to detect the presence of any quartz or silica in any form on the walls and roof of the cave. It would appear then that the crystals of calcite at present lining the cave have not been deposited from the gold-bearing solutions responsible for the formation of the Garibaldi lode.

In the absence of any limestone in the vicinity, the source of supply of calcium carbonate necessary for the formation of these huge crystals of calcite must be sought in the lode material and the impregnated country rock. Calcium carbonate is being deposited on the walls of the different levels of the Garibaldi Mine at the present time at a fairly rapid rate. It is obvious that these waters would be capable of depositing the calcite in the cave, provided that the inlet was greater than the outlet. In this connection it is significant that the cave was full or nearly full of water at the time when it was opened up by the miners. Under these conditions the circulation of the lime-bearing waters within the cave would be very slight and with a constant supply of calcium carbonate the conditions for crystal growth would be ideal.

The crystals occurring in the cave are divisible into two groups: (a) the Rhombohedral-scalenohedral Group and (b) the Prismatic Group. The former group includes all the large crystals and a fair number of the smaller ones, while the latter are invariably small. In general the prismatic crystals are of a later generation than the others; though occasionally they do belong to the same generation (Plate xxviii). Very often they are deposited on the larger crystals and separated from them by a thin layer of calcareous mud. In some specimens, after being kept in a dry place in the Museum for some time, the layer of mud dried and cracked, lifting the small prismatic crystals from off the larger ones.

The evidence of the mud indicates that there must have been a break in the ideal conditions under which the large crystals developed. This break must have been of relatively short duration during which much fine mud was brought into the cave water and deposited along with the calcium carbonate.

Eleven crystals were selected for measurement; nine of these were measured on a two-circle goniometer and the others on account of their size with an ordinary contact goniometer.

It will be seen from Table I that seventeen forms have been recognised. The lettering in this table is according to Goldschmidt and the indices correspond to his G_2 position. Two doubtful forms not shown in the table also occur; one, $r\vdots(\bar{4}\,\bar{1}\,5\,2)$, is represented by two small faces in crystal ii, one giving an excellent signal and the other only a fair. The measured φ and p angles are 10° 10′ and 51° 52′, and the calculated angles are 10° 53′ and 52° 32′. The other form is represented by three narrow faces giving only fair signals and measurements of 2° 17′ and 76° 34′ for the φ and p angles. This does not correspond to any known form, the indices being $(8\ 164\ \overline{172}\ 23)$, and the calculated φ and p angles 2° 22′ and 76° 30′.

Table I: Distribution of forms.

Forms	i	ii	iii	iv	v	vi	vii	viii	ix	x	xi
$o(0001)$		×				×	×		×	×	
$b(1\,1\,\bar{2}\,0)$										×	×
$\gamma(80\bar{8}1)$	×			×	×						
$f\cdot(1\,1\,\bar{2}\,2)$							×				
$\delta\cdot(\bar{1}\,\bar{1}\,2\,2)$							×				
$\eta\cdot(\bar{4}\,\bar{4}\,8\,5)$	×	×	×								
$p\cdot(1\,1\,\bar{2}\,1)$	×	×	×	×	×	×	×	×	×		×
$\xi\cdot(\bar{4}\,\bar{4}\,8\,3)$	×	×									
$\varphi\cdot(\bar{2}\,\bar{2}\,4\,1)$	×	×	×	×	×	×	×	×			
$m\cdot(44\,\bar{8}\,1)$	×	×	×	×	×	×		×			
$\Pi\cdot(\bar{8}\,\bar{\times}\,16\,1)$				×	×						
$e{:}(2\,1\,\bar{3}\,2)$	×	×	×								
$G{:}(11\,5\,\overline{16}\,5)$					×						
$K{:}(4\,1\,\bar{5}\,1)$	×	×	×	×	×	×	×	×	×		
$O{:}(6\,1\,\bar{7}\,1)$			×								
¥:$(\bar{8}\,\bar{4}\,12\,1)$											×
$U(6\,2\,\bar{8}\,1)$	×										

The crystals measured form four distinct types.

Type 1. (Plate xxvii, fig. 1.) Crystals i-iii are of this type and they are all comparatively small. The characteristic forms are the positive rhombohedrons $p\cdot(11\bar{2}1)$ and $m\cdot(44\bar{8}1)$, the negative rhombohedrons $\eta\cdot(\bar{4}\bar{4}85)$ and $\varphi\cdot(\bar{2}\bar{2}41)$, and the scalenohedrons $e{:}(21\bar{3}2)$ and $K{:}(41\bar{5}1)$. In every case the last named form is represented by a full complement of fairly large faces giving excellent signals, and it was by this form that the crystals were centred. The faces of the forms $\eta\cdot(\bar{4}\bar{4}85)$ and $e{:}(21\bar{3}2)$ were dull and sometimes irregularly pitted, in every case giving poor signals. All crystals of this type have a plane of attachment approximately parallel to a plane passing through the vertical axis and one of the horizontal axes.

Crystal i :—This crystal measures approximately 6 mm. × 4 mm. along the vertical and horizontal axes respectively. In addition to the characteristic forms of the type, the second order pyramid $\gamma\cdot(80\bar{8}1)$, the negative rhombohedron $\xi\cdot(\bar{4}\bar{4}83)$, and the positive scalenohedron U$(62\bar{8}1)$ are present. These are all represented by relatively small faces, and in general give only fair signals. The last form is interesting in that it is a comparatively rare form and is represented by its full complement of faces.

Crystal ii :—This crystal measures approximately 5 mm. × 4 mm. along the vertical and horizontal axes respectively. The basal pinacoid is very small and slightly pitted but gives a good signal. The doubtful form ɛ:$(\bar{4}\bar{1}52)$ as described is above also present. With these additional forms and the absence of $\gamma\cdot(80\bar{8}1)$ and $U(62\bar{8}1)$ the crystal is similar to crystal i.

Crystal iii :—This crystal measures approximately 10 mm. × 8 mm., and has only one form, the positive scalenohedron O:$(61\bar{7}1)$, in addition to the type forms. It is represented by two very narrow faces giving rather poor signals.

Type 2. (Plate xxvii, fig. 2.) This type is represented by crystals iv-viii, and includes all the larger crystals as well as some of the smaller ones. The plane of attachment is roughly parallel to the plane of the horizontal axes. The positive rhombohedrons p·$(11\bar{2}1)$ and m·$(44\bar{8}1)$, the negative rhombohedron φ·$(\bar{2}\bar{2}41)$, and the positive scalenohedron K:$(41\bar{5}1)$ are the forms characteristic of this type, though the last form is always present as a relatively small face. The form p·$(11\bar{2}1)$ is generally striated parallel to the edges p·/m· and p·/K:. In the larger crystals m·$(44\bar{8}1)$ and K:$(41\bar{5}1)$ as narrow faces actually alternate with p·$(11\bar{2}1)$ for some distance toward the apex of the crystal.

Crystal iv :—This crystal measures approximately 20 mm. × 16 mm. and in addition to the type forms, Π·$(8\,8\,\overline{16}\,1)$ and $\gamma(80\bar{8}1)$ are also present. Both the forms are represented by small, not very bright faces, giving only fair signals.

Crystal v :—This crystal measures approximately 18 mm. × 20 mm., and is similar to crystal iv except for the additional form G:$(11\,5\,\overline{16}\,5)$ which is represented by its full complement of faces which are generally dull. The striations on p·$(11\bar{2}1)$ are parallel to the edges p·/m· and p·/G:.

Crystal vi :—This crystal measures 18 mm. × 20 mm. The basal pinacoid, which is the only addition to the type forms, is present as a small narrow face giving a very good signal.

Crystal vii :—This crystal measures 22 cm. × 11 cm. and the interfacial angles measured with a contact goniometer are given in table III. The basal pinacoid is a relatively small triangular face. One of the type forms, m·$(44\bar{8}1)$ is not represented, but in addition to the other type forms the positive and negative rhombohedrons f·$(11\bar{2}2)$ and δ·$(\bar{1}\bar{1}22)$ are present, the former being represented by its full complement of faces, the latter by one face only.

Crystal viii :—This is only portion of a crystal having five cleavage faces present and measuring along the edges of the rhomb 23 cm. × 15 cm. × 5·4 cm. Only the type forms are present on this portion of the crystal. The measurements were taken with a contact goniometer.

Type 3. (Plate xxvii, fig. 3.) In crystals of this type the basal plane may or may not be present. The only other forms present are the positive rhombohedrons p·$(11\bar{2}1)$ and the positive scalenohedron K:$(41\bar{5}1)$. This type of crystal appears to be somewhat rare in the cave, as only three specimens containing clusters of crystals of this type were found. The crystals in every case were relatively small.

Crystal ix :—This crystal measures 10 mm. × 10 mm. along the vertical and horizontal axes respectively and was the only crystal of this type measured. Only type forms are present.

Table II. The measured and calculated φ and ρ angles.

Form	Measured				Calculated				Error	
	φ		ρ		φ		ρ		φ	ρ
	°	′	°	′	°	′	°	′	′	′
$o(0\ 0\ 0\ 1)$	...		0	0	...		0	0	...	0
$b(1\ 1\ \bar{2}\ 0)$	29	59	90	0	30	00	90	00	01	0
$\gamma(8\ 0\ \bar{8}\ 1)$	0	01	77	41	0	00	77	37	01	04
$\eta\cdot(\bar{4}\ \bar{4}\ 8\ 5)$	29	50	37	49	30	00	38	17	10	28
$p\cdot(1\ 1\ \bar{2}\ 1)$	30	00	44	39	30	00	44	36	0	03
$\xi\cdot(\bar{4}\ \bar{4}\ 8\ 3)$	29	57	52	50	30	00	52	45	03	05
$\varphi\cdot(\bar{2}\ \bar{2}\ 4\ 1)$	30	00	63	07	30	00	63	07	0	0
$m\cdot(4\ 4\ \bar{8}\ 1)$	29	58	75	43	30	00	75	47	02	04
$\Pi\cdot(\bar{8}\ \bar{8}\ 16\ 1)$	29	59	82	31	30	00	82	46	01	15
$e{:}(2\ 1\ \bar{3}\ 2)$	19	06	36	59	19	06	37	00	0	01
$G{:}(11\ 5\ \overline{16}\ 5)$	17	52	58	13	17	47	58	14	05	01
$K{:}(4\ 1\ \bar{5}\ 1)$	10	52	69	02	10	53	69	02	01	0
$O{:}(6\ 1\ \bar{7}\ 1)$	7	30	75	11	7	35	75	00	05	11
¥: $(\bar{8}\ \bar{4}\ 12\ 1)$	19	06	80	40	19	06	80	35	0	05
$U(6\ 2\ \bar{8}\ 1)$	13	28	76	48	13	54	76	19	26	29

Table III. The measured and calculated interfacial angles for calcite, Lionsville. The measurements were taken with a contact goniometer.

Letter	Angle	Measured		Calculated	
		°	′	°	′
$f\cdot$	$11\bar{2}2 \wedge \bar{2}111$	45	15	45	03
	$11\bar{2}2 \wedge 0001$	26	00	26	15
$p\cdot$	$11\bar{2}1 \wedge 0001$	44	15	44	36
$m\cdot$	$44\bar{8}1 \wedge \bar{8}441$	114	30	114	10
$\delta\cdot$	$\bar{1}\bar{1}22 \wedge 2\bar{1}\bar{1}2$	45	30	45	03
	$\bar{1}\bar{1}22 \wedge 0001$	26	30	26	15
$\varphi\cdot$	$\bar{2}\bar{2}41 \wedge 4\bar{2}\bar{2}1$	101	15	101	09
	$\bar{2}\bar{2}41 \wedge 0001$	63	15	63	07
$K{:}$	$41\bar{5}1 \wedge \bar{4}5\bar{1}1$	75	30	75	22
	$41\bar{5}1 \wedge 5\bar{1}\bar{4}1$	35	30	35	36

Type 4. Crystals of this type possess only the basal pinacoid and the first order hexagonal prism $b(11\bar{2}0)$. In order to determine which prism was present crystal x was cleaved.

Crystal xi (Pl. xxvii, fig. 4) is really a composite crystal and does not belong to any of the types so far described, and so far as the deposit is concerned is quite abnormal. It measures 4 mm. by 2 mm. along the vertical axis and its greatest width respectively. The form $p\cdot(11\bar{2}1)$ is represented by its full complement of faces and the negative scalenhedron γ: $(\bar{8}\,\bar{4}\,12\,1)$ by only half its full complement. The basal pinacoid is striated parallel to the edge o/p. and in places its position is occupied by numerous small rhombohedral terminations. The $\dot{c}$ axis of the two parts of the composite crystal exactly coincide and the horizontal axes are parallel. The first order hexagonal prism $b(11\bar{2}0)$ is present in both parts.

CALCITE.

HANGING ROCK, NUNDLE, NEW SOUTH WALES.

(Pl. xxvii, fig. 5 and Pl. xxix, fig. 2.)

Five specimens of crystallised calcite from Hanging Rock, near Nundle, in the Parish of Nundle, County of Parry, New South Wales, are contained in the Museum collection. Only two forms have been recognised; the positive rhombohedron $f\cdot(11\bar{2}2)$ occurring as large faces giving good signals and the first order hexagonal prism $b(11\bar{2}0)$ as smaller faces generally much corroded and invariably giving bad signals. In some of the smaller crystals the prism faces are entirely absent. The largest crystal measures 3 cm. × 6 cm. along the vertical axis and the horizontal axes respectively. They are associated with crystallised quartz. On some of the crystals minute crystals of pyrite are deposited. They are so small that their form cannot be distinguished under the pocket lens but under the microscope they are seen to be perfectly formed octahedral crystals. It is interesting to note that they appear to be very much more numerous on and about the prism faces.

Table V. The average measured and calculated φ and ρ angles for calcite, Hanging Rock, Nundle.

Form	Measured				Calculated				Error	
	φ		ρ		φ		ρ		φ	ρ
	°	′	°	′	°	′	°	′	′	′
$b(1\,1\,\bar{2}\,0)$	29	55	89	47	30	00	90	00	05	13
$f\cdot(1\,1\,\bar{2}\,2)$	29	56	26	17	30	00	26	15	04	02

Acknowledgments.

To Mr. Anthony Hordern, who generously defrayed expenses in connection with the field work, Dr. W. F. Straubel, Manager of the Garibaldi Mine, who afforded every facility, and my colleague, Mr. C. M. G. Friend, who assisted both in the field and in checking calculations, many thanks are due.

A REVIEW OF AUSTRALIAN HELMET SHELLS
(FAMILY CASSIDIDAE—PHYLUM MOLLUSCA)

BY

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(Plates xxxi-xxxii.)

No connected account of the shells known as Helmet Shells has yet appeared in Australian literature, though many species have been listed by Hedley, Verco, May, Pritchard, Gatliff and Gabriel. The majority of these occur in temperate Australian waters, and many different interpretations of the species exist. An attempt is here made to correlate the information available by means of the material gathered together in the Australian Museum, supplemented by loan of specimens from the workers above named, and to supply a criticism of literature. This review was begun some years ago and has proved of a very complex nature, both as regards the literary side and the conchological aspect.

True Helmet Shells are common to the tropics, one or two species reaching into northern Australia, but in Australia, more numerously in the southern parts, many species of what may be termed " False Helmet " shells occur. Hitherto these two main groups have been commonly recognized, but sometimes only subgeneric rank has been allowed the latter. Many sub-groups have been accepted, but generally authors have differed as to the extent and nomination of these groups. In the present essay the names proposed are detailed so that easy criticism may ensue: small groups are utilised, as, though fossil forms are known, only in few instances can lineage be traced, and in these cases the recent forms have been found to have persisted practically unchanged since the Eocene. Little has been done in connection with the comparative anatomy of the groups, but years ago Troschel recorded that the radula showed differences in the two main groups that were worthy of generic rank, and that differences were visible in other species to which he allotted subgeneric value. As Troschel's values were higher than those of present day usage further comparisons will undoubtedly emphasise the separative features and confirm the smaller groupings advocated. All the types and the specimens figured are in the Australian Museum. The beautiful figures provided are from the brush of Miss Joyce K. Allan, of this Museum, to whom my best thanks are here tendered, for the illustrations enhance the value of this paper two-fold. It should be recorded that the bulk of the paper deals with what has been known as the " *pyrum-achatina* " series. and the paintings refer more especially to this group.

As no list of Australian Cassids has previously been prepared, a summary of the conclusions here published will be acceptable.

Cassis cornuta (Linné 1758, *Buccinum*). North Queensland.
 spinosa (Meuschen 1781, *Buccinum*). Australia.
 [*flammea* (Linné 1758, *Buccinum*). Australia. Error.]

Nannocassis nana (Tenison-Woods 1879, *Cassis*). South Queensland, Northern New South Wales.

torva Iredale 1927. South Queensland.

Hypocassis fimbriata (Quoy and Gaimard 1833, *Cassis*). Western Australia.

bicarinata (Jonas 1839, *Cassis*). Western Australia, South Australia, Victoria.

Cypraecassis rufa (Linné 1758, *Buccinum*). North Queensland.

Phalium glaucum (Linné 1758, *Buccinum*). Queensland.

areola (Linné 1758, *Buccinum*). Queensland, northern New South Wales.

bandatum (Perry 1811, *Cassidea*). Queensland, northern New South Wales, North Western Australia.

agnitum Iredale 1927. Western Australia.

Xenophalium hedleyi Iredale 1927. New South Wales.

Semicassis diuturna Iredale 1927. Queensland, northern New South Wales, Northern Territory(?).

Casmaria erinaceus (Linné 1758, *Buccinum*). North Queensland.

vibex (Linné 1758, *Buccinum*). North Queensland.

ponderosa (Gmelin 1791, *Buccinum*). Queensland, northern New South Wales.

Xenogalea pyrum (Lamarck 1822, *Cassis*). Southern New South Wales, Victoria, Tasmania.

stadialis (Hedley 1914, *Cassidea*). New South Wales, Victoria, Tasmania (?).

thomsoni (Brazier 1875, *Cassis*). New South Wales.

sophia (Brazier 1872, *Cassis*). New South Wales, south Queensland (Kermadec Islands).

nivea (Bra ier 1872, *Cassis*). West Coast of Tasmania, South Australia.

paucirugis (Menke 1843, *Cassis*). Western Australia.

lucrativa Iredale 1927. North Queensland.

labiata (Perry 1811, *Cassidea*). New South Wales, South Queensland, Victoria(?), Norfolk I.

insperata Iredale 1927. New South Wales, south Queensland.

angasi Iredale 1927. South Queensland, and northern New South Wales.

Antephalium semigranosum (Lamarck 1822, *Cassis*). Victoria, Tasmania, South Australia, south Western Australia.

adcocki (Sowerby III, 1896 *Cassis*). Victoria, South Australia, south Western Australia.

sinuosum (Verco 1904, *Cassidea*). South Australia, Victoria.

Fossil Forms.

It is necessary to survey the known fossil forms of any group when dealing with deep water shells, but in the present instance very little information is available, so the little may be here incorporated.

Tate in 1889[1] catalogued the known fossil species as follows : *Semicassis transenna* Tate (p. 166, pl. viii, fig. 2) from Lower Beds, Muddy

[1]Tate—Trans. Roy. Soc. S. Australia, xi, 1888 (April, 1889).

Creek, Victoria: " no analogue in living creation." *Semicassis subgranosa* Tate (p. 166, pl. vii, fig. 10), from raggy limestones, Edithburgh, South Australia: "shape of *semigranosa*." *Semicassis muelleri* Tate (p. 167, pl. vii, fig. 9), from Upper Beds, Muddy Creek: "resembles in miniature *S. nivea* Brazier, but with a different ornament." *Semicassis trinodosa* Tate (p. 167, pl. vii, fig. 12), from Bairnsdale, Gippsland, Victoria: "has the shape of *S. abbreviata* Lamarck, recent on the west coast of Tropical America." *Semicassis radiata* Tate (p. 168, pl. viii, fig. 3), from well sinking, Murray desert: "approaches the nodulate variety of *S. torquata* Reeve, recent in temperate waters of Australia." *Cassis sufflata* Tenison-Woods[2] was included as an unfigured species from Table Cape, Tasmania, without comment. Harris[3] recorded *Semicassis sufflata* = *transenna* ex Pritchard, and *S. muelleri*, observing of the latter, "it is, apparently, the precursor of the living *S. nivea* Brazier, of the Australian Seas." Dennant and Kitson[4] refer to the Eocene and Oligocene, *Semicassis sufflata* Tenison-Woods, *S. transenna* Tate, and *S. radiata* Tate.

To the Miocene were relegated *S. muelleri* Tate, *S. trinodosus* Tate, and *S. subgranosus* Tate, while from the Newer Pliocene of Limestone Creek, Glenelg River, Victoria, *S. semigranosus* Lamarck, was recorded. A note is added "Mr. Harris credits me with presenting this [*S. sufflata*] as a Muddy Creek species to the British Museum. I observe (1) that it does not occur at Muddy Creek, and (2) that the shell I sent was *S. transenna*, a distinct species. J.D."

European palaeoconchologists have usually endeavoured to associate Australian forms with their fossils, so that we find Sacco[5] arranging under the subgenus *Semicassis* a sequence thus:

"Living: *saburon* and *undulata*.
Pliocene fossil: *laevigata*.
Miocene fossil: *miolaevigata*.
Eocene fossil: *muelleri* and *transenna*. Australia,"

and under subgenus *Echinophoria* Sacco (p. 39)

> "No living representative of this group, but the Australian *E*.(?) *torquata* Reeve may be a probable ally, whose fossil ancestor may be the Eocene *S. radiata* Tate."

Cossmann[6] disagrees almost entirely with Sacco's arrangement, placing *Echinophoria* Sacco as a synonym of *Semicassis* (p. 125), but admitting as a distinct subgenus (p. 127) *Casmaria* H. and A. Adams, with the living *C. pirum* Lamarck as type; he figures as plesiotype, *Semicassis muelleri* Tate, from the Muddy Creek, and names *transenna* Tate as the Oligocene representative.

These values and relationships cannot be accepted, as *transenna* and *muelleri* appear to belong to different stocks, and neither of them is referable to the *saburon* series, and probably none have any close alliance with the Palaearctic fossils. Material is still insufficient to allow dogmatism, but *muelleri* really appears to be closely related to the living *nivea* and

[2]Tenison-Woods—Proc. Roy. Soc. Tasm., 1867, 21, 1879 (*fide* Tate, *recte* Pap. Proc. Roy. Soc. Tasm., 1876, (1877), p. 93).
[3]Harris—Cat. Tert. Moll. Brit. Mus., pt. i, 1897, p. 198.
[4]Dennant and Kitson—Rec. Geol. Surv. Vict., i, 2, 1903, p. 108.
[5]Sacco—Mem. del. Real. Accad. Sci. Torino, (2), xi, 1890.
[6]Cossmann—Essais de Paléoconch. comp., livr., 5, 1903, p. 119, *et seq.*

to be strictly ancestral. The age of *muelleri*, however, cannot be regarded as Eocene, and scarcely Miocene. The species *transenna* is undoubtedly older than *muelleri*, but does not belong to the same group, being related to *sinuosa* and *adcocki*. These latter are living, but are restricted to the Adelaidean province and are rare deeper water species. These may be comparable with *Xenogalea labiata*, which now lives only on the East Coast, and which may be a distant relative of the western *paucirugis*. With regard to the fossil *sufflata* from Table Cape, it may be a little younger, but nearly allied to the Muddy Creek *transenna*.

Systematic Account.

Genus Cassis *Scopoli.*

1772. *Cassida* Brunnich, Zool. Fund., p. 248 ; name and diagnosis only, exactly as *Tonna* and equally acceptable, were it not invalidated by *Cassida* Linné, Syst. Nat., 1758, ed. x.

1777. *Cassis* Scopoli, Introd. Hist. Nat., p. 393; first species, *Bucc. flammeum*, but includes *Bucc. cornutum*. Type by subsequent designation, Montfort, Conch., 1810, p. 559, *Bucc. cornutum*.

1789. *Cassidea* Bruguière, Ency. Meth. Vers., I, p. xv, diagnosis only.

1792. ,, ,, ,, ,, p. 414: new name instead of *Cassis* Klein, contents differing. Type by subsequent designation, Cossmann, Essais de Paléoconch. comp., livr. 5, 1903, p. 123, *Bucc. cornutum* Linné.

1797. *Cassida* "Humphrey," Museum Calonnianum (May 1), p. 19. Not *Cassida* Linné, Syst. Nat., 1758, ed. x.

1798. *Cassidea* Cuvier, Tabl. Elem. Hist. Nat., p. 406 : includes *cornutum*.

1798. *Cassis* Bolten, Museum Boltenianum, p. 28.

1799. *Cassis* Lamarck, Mem. Soc. d'Hist. Nat. Paris, p. 72 (May). Type, by monotypy, *Buccinum cornutum* Linn.

1801. *Cassis* Lamarck, Syst. Anim. sans Verteb., p. 79 (Jan.). Type, by monotypy, *Buccinum cornutum* L.

1802. *Cassidea* Bosc, "Hist. Nat. Coquilles, v, ex Bruguière": 3rd edition, 1836, p. 1.

1804. *Cassis* Duvernoy, Dict. Sci. Nat., ed. I, v, p. 404.

1805. *Cassis* Roissy, Hist. Nat. Moll., vi, p. 98 ; for "Casque Bruguière."

1807. *Cassidea* Link, Beschr. Nat. Samml., Rostock, pt. 3, p. 111 ; for part of Bruguière's genus : includes *cornuta*, etc.

1810. *Cassis* Montfort, Conch. Syst., 599. Type, by original designation, *Buccinum cornutum* Linné.

1815. *Cassinia* Rafinesque, Analyse de la Nature, p. 145 (*Cf.* Iredale, Proc. Malac. Soc. (Lond.), ix, 1911, pp. 261, 262) : new name for "*Cassis* Brug."

1816. *Cassidea* Bosc, Nouv. Dict. d'Hist. Nat., nouv. ed., v, p. 347 : for the genus "Casque Bruguière."

1817. *Cassidea* Schumacher, Essai nouv. Syst. Vers., test, pp. 75 and 247, as of Bruguière. Includes *B. rufum* Linné and *B. flammeum* Linné.

1817. *Cassis* Blainville, Dict. Sci. Nat. (Levrault), vii, p. 203, for the "genre Casque."
1817. *Cassidea* id. ib. p. 226; note of proposal for the same genus by Bruguière.
1822. *Cassis* Lamarck, Hist. Nat. Anim. sans Verteb., vii, p. 218, Aug.: for the genus "Casque": second species *C. cornuta* ex L.
1823. *Cassis* Bory de Saint Vincent, Dict. Class. d'Hist. Nat., iii, p. 245, as of Lamarck.
Cassidea id. ib. p. 255, as Bruguière's name for same group.
1838. *Cassidea* Schlüter, Kurz. Syst. Verz. Conch., p. 19, as of Bruguière, for *pennata* Brug., *testiculus* Brug., etc.
1838. *Cassis.* id. ib. for *tuberosa* Lamarck, *flammea* Lam., *rufa* Lamarck, etc.
1846. *Cassis* Hermannsen, Index Malac., p. 195, as of Swainson, 1840. Type, *Cassis cornuta* Linné.
1857. *Goniogalea* Mörch "Cat. Suenson." Not seen.
1877. *id.* ib. Malak. Blatt, xxiv, p. 37, ex "Cat Suenson" for *madagascariensis* Lam., *flammea* L., and *tuberosa* L.
1882. *Fimbriola* Scudder, Nomencl. Zool. ex Megerle MS.=*Cassis*. *Cf.* Iredale, Proc. Malac. Soc. (Lond.), xiv, 1921, p. 204.
1890 *Galeodocassis* Sacco, Mem. del. Real. Accad. Sci. Torino, (2), xi, (I. Moll. test. tert. Piemonte and Liguria, pt. vii), p. 18. Type, by virtual monotypy, *C. anceps* Sacco.
1890. *Cassis* Cossmann, Ann. Soc. Roy. Malac. Belg., xxiv, p. 107; as of "Klein 1753." Type, by original designation, *C. flammea* L.
1899. *Cassisoma* Rovereto, Atti. Soc. Ligustica, x, p. 107: new name for "*Cassis* Klein 1753, nec. Klein 1734."
1903. *Cassidea* Cossmann, Essais de Paleoconch. comp., livr. 5, 123; as "of Bruguière 1789 = *Cassis* Lamarck, 1799 not Klein 1734 = *Casida* Humphrey 1797, error typogr.. non *Cassida* Lang 1722, nec Linn. 1735, nec Gevers. 1787 = *Cassisoma* Rovereto 1899." Type, by original designation, *Buccinum cornutum* Lin.
1909. *Cassis* Dall, and most recent authors.

Huge massive shells with planate spire, regularly variced, mouth elongate, narrow, contracted, inner lip wrinkled, outer lip recurved, flattened, swollen medially with a dozen long denticles, minute umbilicus; canal recurved into an upturned snout. Sculpture punctate or smooth, more or less nodulose.

The somewhat complex synonymy here displayed needs a little explanation. Malacological systematists are indebted to Dr. W. H. Dall for the elucidation of the majority of problems, and as a general rule his results have been accepted without criticism. In the present case, though his conclusions are valid, some of the arguments presented need emendation, and the facts are here reviewed. Dall[7] discussed the names proposed in this family and admitted two genera, *Cassis*, and *Phalium*. He referred *Cassis* to the authority of Scopoli, and noted that Scopoli's assemblage was very similar to that of Klein, whose introduction of the name *Cassis* was pre-Linnean. As a matter of fact, Scopoli

[7]Dall—U.S. Geol. Survey, Prof. Paper, 59, 1909, pp. 57-69.

acknowledges the genus as that of Klein. Dall then utilised *Phalium* Link for the shells typified by *Buccinum glaucum* Linné, but included as a subgenus, " *Cassidea* (Bruguière) Swainson " explaining " *Cassidea* Bruguière, Encycl. Meth., I, pp. xv (1789), 414 (1792); new name for *Cassis* Klein (*cf*. p. 416, col. 1): first species, *Buccinum vibex* L. *Cassidea* Swainson, Malac., p. 299, 1840; type, *Cassis vibex* L." For this conclusion details were furnished thus: " In the matter of names for the divisions of *Phalium* it may be noted that the *Cassidea* of Bruguière was proposed as a substitute for *Cassis* Klein 1753, not 1734, and *Cassis* Klein contained none of the typical genus *Cassis*, so *Cassidea* Bruguiere cannot be used for the latter. *Cassidea* was a heterogeneous group until Swainson fixed on *C. vibex* to typify it in 1840. As the first section of *Bezoardica* Schumacher was already a synonym of *Phalium*, the name can be retained for the second section for which the much later name of *Semicassis* Mörch has been frequently used." If this were accepted as written, the Rules demand the usage of the earlier name *Cassidea* in place of *Phalium*, and I so used that name when introducing my species *C. royana*. Later, re-investigating the matter, I advised Hedley to use *Phalium*, which he did, but the reasons have not previously been published by either of us. The facts are as follows.

Bruguière introduced the genus name *Cassidea* for the genus *Casque*, but the diagnosis only was published in 1789. In 1792 on page 414, as cited by Dall, the genus was fully dealt with, and on page 416 Bruguière gave his reasons: " Bonanni est le premier qui aie trouvé quelque ressemblance à ces coquilles avec la forme d'un casque, & qui les aie nommées par cette raison *Cochleæ galeæformes*. Les autres Conchyliologistes adoptèrent dans la suite cette premiére idée de Bonanni, dont est venu le mot générique de *Cochlea cassidiformis* de Gualtieri, celui de *Cassis* de Klein, & le casque des Auteurs François. En adoptant cette dénomination Françoise, parce qu'elle est généralement reçue, je ferai un léger changement au mot latin de Klein, parce que s'il est utile d'indiquer l'analogie qu'on trouve entre le forme de ces coquilles & celle des casques des anciens guerriers, on ne doit pas cependant confondre sous un même nom latin les casques des guerriers, & des coquilles qui, à tout prendre, n'ont avec eux qu'une ressemblance très-éloignée." Further Bruguière states that his genus *Cassidea* does not coincide with that of Klein, being more comprehensive. In Bruguière's genus are included *vibex*, *glauca*, *rufa*, *cornuta*, etc., *i.e.*, all the species mentioned by Scopoli in his *Cassis* so that they are practically co-equal. Dall's argument that, because Klein's group contained no true *Cassis*, Bruguière's genus could not be used, is not valid, as the usage of a pre-Linnean name by a post-Linnean worker does not bind the latter to accept the sense of the earlier writer. This is clearly seen in Linné's own work, as he utilized many generic names in anything but the previous understanding. Dall's claim that *Cassidea* Bruguière was fixed by Swainson in 1840 is misleading. Its acceptance would necessitate the usage of *Cassidea* in place of *Phalium*, but the history of *Cassidea* obviates that necessity. Probably the first definite reviser was Link, who restricted *Cassidea* Bruguière to *rufa*, *cornuta*, *flammea*, etc., providing *Phalium* for *glauca* and others, a perfectly legitimate action. Previously, Cuvier and Bosc had followed

Bruguière in using *Cassidea* for the whole series, whereas Bolten and Lamarck have revived *Cassis* and this name was accepted by Montfort. *Cassidea* was independently proposed by Perry for a conglomerate series. Rafinesque introduced a novel emendation, *Cassinia* for " *Cassis* Brug.," while Schumacher divided the group exactly as Link, of whose work he was probably ignorant, but used *Cassidea* and *Bezoardica*, the latter exactly equivalent to Link's *Phalium*. Swainson *then independently* introduced *Cassidea* for the open-mouthed series of Helmet Shells, for which *Phalium* and *Bezoardica* were already in literature, but did not cite a species. This was remedied by Sowerby, who figured a specimen under the name *C. erinaceus*, which name he later altered to *C. glauca*, but the figure seems referable to neither. Then Swainson utilized *Cassidea*, still claiming the genus as his own, and included a large number of species, figuring, probably inattentively, *vibex*, but this figure cannot be construed in any way as a type selection. As a matter of fact Hermannsen definitely designated, as type of *Cassidea* Swainson 1840, *Cassis areola* Lamarck. As this is one of the series allotted to his genus by Swainson, this type designation is valid, and consequently Dall's suggestion as to the type of *Cassidea* (Bruguière) Swainson cannot be confirmed.

An innovation which does not seem to have received careful consideration in recent years was that made by Stutchbury when he introduced *Cypraecassis*, designating *Cassis rufa* as type.

Cassis cornuta (*Linné*).

1758. *Buccinum cornutum* Linné, Syst. Nat., Ed. x, p. 735, based on Bonan. recr. 3, t. 155. Rumph. mus., t. 23, f. 1. Gualt. test., t. 40, f. D. " *Habitat* " in America.

1876. *Cassis cornuta* Brazier, Proc. Linn. Soc. N.S.W., i, p. 234. " Quite common throughout Torres Straits."

1910. *Cassis cornuta* Hedley, Rep. Austr. Ass. Adv. Sci., Brisbane, 1909, p. 361. Queensland.

Distribution.—North Queensland; extra-limital.

Cassis spinosa (*Meuschen*).

1781. *Buccinum spinosum* Meuschen, Zoophyl. Gronov., fasc. iii, Expl. to plates, Tab. xix, (fasc. iii, tab. ii), fig. 9, p. 302, no. 1344. index. " Habitat in America."

1789. *Buccinum fasciatum* Bruguière, Ency. Meth. Vers., i, p. 247; whilst cited as a synonym by Tryon, is a species of *Tonna*. Not of Müller, Vermes, ii, 1774, p. 145.

1791. *Buccinum tessellatum* Gmelin, Syst. Nat., pt. vi, p. 3476, based on "Seba, mus., 3. t. 73, f. 1, 12, 13 : Martin. Conch., 2, t. 36, f. 369, and t. 37, f. 374. Oceano australi." Not of Martyn, Univ. Conch., iii, 1786, pl. 85.

1791. *Buccinum maculosum* Gmelin, Syst. Nat., pt. vi, 3476, based on " List. Conch., t. 997, f. 62. Hab. ? " Not of Martyn, Univ. Conch., i, 1784, pl. 8.

1791. *Buccinum rumpfii* Gmelin, Syst. Nat., pt. vi, 3491, based on " Rumpf. mus., t. 25, f. 3. Hab. ? "

1798. *Cassis coronata* Bolten, Mus. Bolten, pt. ii, 29, based on " *tessellatum* Gmel. *pars* = Martini, 2, t. 36, f. 369 and t. 37, f. 374."

1840. *Cassis fasciata* Swainson, Treat. Malac. 299 (May), based on " Mart., 37, f. 384 " (*recte* 374).

1923. *Cassis rumpfii* Hedley, Rec. Austr. Mus., xiv, p. 47.

Distribution.—North Australia; extra-limital.

Remarks.—Hedley at the place quoted included this species under the name *C. rumpfii* Gmelin, but noted that the earliest name was *Buccinum spinosum* Gronovius, 1781, which however had been rejected as non-binomial. Six months later there appeared an article by Dr. Dall[8] entitled " F. C. Meuschen in the Zoophylacium Gronovianum " wherein the opinion, that this was not a binomial work, is retracted, and that therefore the names in Meuschen's index in this work are valid. Reference to the book itself confirms Dall's conclusions, as in the introduction it is definitely stated that the Linnean system was accepted, and consequently Meuschen's name is here used.

CASSIS FLAMMEA (*Linné*).

1758. *Buccinum flammeum* Linné, Syst. Nat., Ed. x, p. 736, based on " Bonan., recr. 3, t. 161, and Rumph. mus., t. 23, f. 2. Habitat ? "

1826. *Cassis flammea* J. E. Gray, Survey Intertrop. Coasts Austr. (King), ii, p. 485, " 1827 " = April 18, 1826.

This appears to be the only note of this well-known species in Australian literature, and as Tryon[9] includes it from the West Indies only, citing East Indian localities as erroneous, it would appear to have no legitimate claim.

Genus NANNOCASSIS, *nov.*

The genotype, *Cassis nana* Tenison-Woods, is like a miniature *Cassis* but is much more solid, with the outer lip more closely and regularly denticulate, while the inner lip is finely wrinkled throughout its length, with no internal teeth, but a median groove on the anterior portion indicating the false umbilical canal.

NANNOCASSIS NANA (*Tenison-Woods*).

1879. *Cassis nana* Tenison-Woods, Proc. Linn. Soc. N.S.W., iv, p. 108. Moreton Island, Queensland.

1899. *id.* Hedley, ib. xxiv, p. 434, fig. 6 in text. Ballina, N.S. Wales.

1910. *id.* id. Rep. Austr. Ass. Adv. Sci., Brisbane, 1909, p. 361.

1918. *id.* id. Check List, p. M .67, *in* Journ. Proc. Roy. Soc. N.S. Wales, li (1918).

Distribution.—South Queensland; northern New South Wales.

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[8] Dall—Nautilus, xxxvii, Oct., 1923, pp. 44, *et seq.*

[9] Tryon—Man. Conch., vii, 1885, p. 271.

NANNOCASSIS TORVA *Iredale* 1927.

A very distinct dead shell was collected at Caloundra, South Queensland, by Mr. Nicholson, which proved to be a new species closely related to *Nannocassis nana.* It differs in its larger size and persistent longitudinal and spiral sculpture, and will be figured in a later publication.

Genus HYPOCASSIS, *nov.*

As genotype of this group *Cassis bicarinata* var. *decresensis* Hedley is selected, the two species, *Cassis bicarinata* Jonas, and *Cassis fimbriata* Quoy and Gaimard, having been introduced without definite locality. While this group superficially resembles *Cassis,* the fact that it has a long lineage in the south of Australia deserves a peculiar nomination. Thus three fossils have been described, and, though these are of some age, they show little variation from the living species. Medium to large medium shells with many varices present, spine very short, whorls strongly shouldered and nodulose, additional nodular rows present, mouth narrow, outer lip thickened, folded back, internally faintly denticulate with few teeth, columella nearly straight, widely reflected over the body whorl, false umbilicus narrow but open, umbilical cavity present.

HYPOCASSIS FIMBRIATA (*Quoy and Gaimard*).

1833. *Cassis fimbriata* Quoy and Gaimard, Voy. Astrol., Zool., ii, p. 596, pl. xliii, figs. 7-8. Mariannes (error) = Western Australia.

1923. *Cassis fimbriata* Hedley, Rec. Austr. Mus., xiv, p. 46, pl. viii, fig. 2. North Western Australia.

Distribution.—Western Australia.

Remarks.—At the place cited Hedley has distinguished between the Western Australian shell and the South Australian one, regarding the former as the true *fimbriata.* His conclusions are here accepted with reserve, as the few additional specimens examined suggest intergradation, and that the differential values are less than specific.

Cassis exigua was described by Tenison-Woods[10] from a juvenile shell, and refigured from adult specimens compared with type from the lower beds of Muddy Creek by Tate,[11] who declared: "Resembles *C. fimbriata,* recent in Southern Australia, from which it differs particularly by the spiral sculpture." West Australian shells of the recent *C. fimbriata* retain the spiral sculpture which characterizes the immature stages, but there are fifteen nodules on the angle of the body whorl whereas the fossil is described and figured with only twelve. Consequently, the fossil appears to be strictly related.

Cassis textilis was introduced by Tate [12] and later figured[13] from the calciferous sandstones of the River Murray cliffs near Morgan, and sandrock from Cheltenham, Port Phillip Bay. Tate observed "differs in shape from the recent *C. fimbriata,* and its fossil representative, *C. exigua,* by being more ventricose, and by its longer spire. Its spiral ornamentation and triple row of tubercles further distinguish it from *C. fimbriata.*"

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[10]Tenison-Woods—Proc. Linn. Soc. N.S.W., iv, 1879, p. 17, pl. ii, fig. 7.
[11]Tate—Trans. Roy. Soc. S. Australia, xi, April, 1889, p. 164, pl. vii, fig. 13.
[12]Tate—Trans. Roy. Soc. S. Australia, v, 1882, p. 45.
[13]Tate—*Ibid.*, xi, Apl., 1889, p. 165, pl. xii, fig. 11.

The latter has spiral sculpture, and sometimes three rows of nodules so that this fossil would also appear closely related.

Semicassis trinodosa was contrasted by its describer Tate[14] with a recent tropical West American shell, but as it was fossil at Bairnsdale, Gippsland, the figure suggests that comparison should have been with this kind of shell.

HYPOCASSIS BICARINATA (*Jonas*).

1839. *Cassis bicarinata* Jonas, Archiv. Naturg. (Wiegmann), Jahrg. v, Bd, i, p. 343, pl. x, f. 2. "China," error = South Australia.

1923. *Cassis bicarinata* Hedley, Rec. Austr. Mus., xiv, p. 46, pl. viii, fig. 1. S.A.
var. *decresensis* id. ib., Kangaroo Island (refers to *Cassis fimbriata* Kiener, Coquilles Vivants, 1835, p. 12, pl. iv, fig. 6 for illustration).

Distribution.—South Australia, Victoria, south Western Australia.

Remarks.—Hedley regarded the large South Australian shell known as "*fimbriata*" as a distinct species for which he used the above name. More material is needed to determine the exact relationship, as there seems to be much variation in connection with the present form.

Genus CYPRAECASSIS *Stutchbury.*

1837. *Cypraecassis* Stutchbury, Mag. Nat. Hist. (Charlesworth), i, p. 214. Type, by original designation, *Cassis rufa.*

This genus is non-varicose save for the outer lip, which is thick and reflected, swollen throughout its length, and posteriorly developed into a pronounced canal reaching above the planate spire; the inner lip is developed into a heavy flange, finely wrinkled throughout its length, wrinkles more prominent internally, but not forming strong teeth. The juvenile grows quite differently from that of typical *Cassis*, being more like a young *Cypraea.*

CYPRAECASSIS RUFA (*Linné*).

1758. *Buccinum rufum* Linné, Syst. Nat., Ed. x, p. 736, based on "Rumph. mus., t. 23, f. B; Barrel. rar. 1325, f. 29; Gualt. test., t. 40, f. E.; Kratzenst. Regenf., t. 12, f. 69." Habitat "in Oceano Americano."

1797. *Cassida os-tauri* "Humphrey," Museum Calonnianum (May 1), p. 19. New name for *Buccinum rufum* Linn.

1911. *Cassidea rufa* Shirley, Proc. Roy. Soc. Queensland, xxiii, p. 98 (Murray Island).

Distribution.—North Queensland: extra-limital.

Genus PHALIUM *Link.*

1807. *Phalium* Link, Beschr. Nat. Samml., Rostock, pt. 3, p. 112: for part of "*Cassis* Brug., Bolt.," includes *glaucum, areola,* etc. Type, *B. glaucum,* Linn.

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[14]Tate—Trans. Roy. Soc. S. Australia xi, April, 1889, p. 167, pl. vii, fig. 12.

1817. *Bezoardica* Schumacher, Essai nouv. Syst. Vers. test., pp. 75 and. 248. Type, by virtual tautonymy, *B. vulgaris* = *B. glaucum* Linn.

1835. *Cassidea* Swainson, Elem. Mod. Conch., p. 18: diagnosis only.

1839. *Cassidea* Sowerby, Manual Conch. 1st ed., p. 20, as of Swainson. Type, by monotypy, *C. erinaceus*, fig. 411.

1842. *id.* ib. 2nd ed., p. 99: same figure used, but name changed to *C. glauca* in text, but not in Expl. plate, p. 307.

1840 *Cassidea* Swainson, Treat. Malac., pp. 66 and 299; many species including *areola* and *vibex*, the last named figured.

1846. *Cassidea* Hermannsen, Index Malac., p. 192, as of "Swainson, 1840." Type designated, *Cassis areola* Linn. = *Bezoardica* Schum.

1852. *Cassidea* Hermannsen, Index Malac. Suppl., p. 25, as of "Swains. 1835, Elem. = *Phalium* Link."

Medium sized shells, oval, spire about half length of aperture, acuminate, varices present, mouth rather narrow, outer lip folded back and internally denticulate generally, prickly anteriorly, false umbilicus open, umbilical chink or perforation present.

The species are very similar, yet easily differentiated by means of coloration, thus:

Dull bluish grey; shoulder plicate; anterior prickles on outer lip pronounced .... *glaucum*
White with five bands of large red square spots; shoulder not angulate nor plicate; anterior prickles on outer lip obsolete .... *areola*
Bluish with five indistinct reddish bands; shoulder angled and coronate; spire more elate; anterior prickles on outer lip subdued .... *bandatum*
White; shoulder not angulate, closely plicate; anterior prickles on outer lip obsolete .... *agnitum*

PHALIUM GLAUCUM (*Linne*).

1758. *Buccinum glaucum* Linné, Syst. Nat., x, ed., p. 737, based on "Rumph. mus., t. 25, f. A.; Gualt. test., t. 40, f. A." "Habitat in O. Asiatico."

1786. *Buccinum galea-ferrea* Martyn, Univ. Conch., pt. iii, 1786, pl. xci, right hand fig. China.

1797. *Cassida bezoar* "Humphrey," Museum Calonnianum (May 1), p. 19. New name for *Buccinum glaucum* Linné.

1817. *Bezoardica vulgaris* Schumacher, Essai nouv. Syst. Vers. test., p. 248. New name for *Buccinum glaucum* Linné.

1910. *Cassidea glauca* Hedley, Rep. Austr. Ass. Adv. Sci., Brisbane, 1909, p. 361. Queensland.

1911. *Cassidea strigata* Shirley, Proc. Roy. Soc. Queensland, xxiii, p. 98: juvenile.

Distribution.—North Queensland; extra-limital.

PHALIUM AREOLA (*Linné*).

1758. *Buccinum areola* Linné, Syst. Nat., x, ed., p. 736, based on "Bonan. recr. 3, t. 154. Rumph. mus., t. 25, f. 1, B. 2. Gualt. test., t. 39, f. H, G. Argenv. conch., t. 18, f. I." "Habitat in M. Mediterraneo."

1873. *Semicassis* (*Phalium*) *areola* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 837. N.S. Wales.

1910. *Cassidea areola* Hedley, Rep. Austr. Ass. Adv. Sci., Brisbane, 1909, p. 361. Queensland.

1918. *Phalium areola* Hedley, Check List, p. M. 67, *in* Journ. Proc. Roy. Soc. N.S. Wales, li (1917). N.S. Wales.

Distribution.—Queensland; New South Wales; extra-limital.

PHALIUM BANDATUM (*Perry*).

1811. *Cassidea bandata* Perry, Conchology, pl. xxxiv, fig. 2. East Indies.

1825. *Cassis coronulata* Sowerby, Cat. Shells, Tankerville, app., p. xx; no locality cited.

1873. *Semicassis* (*Phalium*) *coronulata* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 838. N.S. Wales.

1910. *Cassidea coronulata* Hedley, Rep. Austr. Assoc. Adv. Sci., Brisbane, 1909, p. 361. Queensland.

1917. *Cassis coronulata* Odhner. K. Sv. Vet. Akad. Handl., lii, 16, p. 11; Broome, north-western Australia.

1918. *Phalium coronulatum* Hedley, Check List, p. M. 67, *in* Journ. Proc. Roy. Soc. N.S. Wales, li (1917). N.S. Wales.

Distribution.—Queensland; New South Wales; north-western Australia: extra-limital.

This well-known species was first figured and described by Perry. The illustration is easily recognisable, while the description gives the diagnostic features of the species.

PHALIUM AGNITUM, *sp. nov.*

(Plate xxxii, fig. 10.)

Shell small, ovate, thin but strong, spire short, acute, about one third the length of the body whorl, heavily variced, a varix at two thirds the length of a whorl for the last three whorls, aperture narrowly ovate, attenuate posteriorly, sculpture on early whorls reticulate, body whorl spirally sulcate and longitudinally striate. Coloration white. Apical whorls worn down, six adult whorls remaining, earlier ones spirally ridged, slender threads longitudinally over-riding these with a slight slant backwards; the ridges strengthen into three prominent ones, but there is only a slight tendency to shoulder. In the antepenultimate the longitudinals become stronger and a spiral thread appears above the shoulder; on the penultimate two spiral threads are seen, and on the last whorl five or six similar threads occur above the shoulder, but below these are replaced by fine sulci, which number about thirty, the base of the whorl showing every alternate one much broader. These are over-ridden by about thirty, slanting, fine longitudinal lirae which form squarish nodules on the shoulder but fade away as they approach the base; half a dozen are crowded together just behind the varix. Canal very recurved and

preceded above by a deep gutter, running into the false umbilicus, which is choked by the preceding varix. Columella nearly straight, finely wrinkled throughout, wrinkles emphasized anteriorly, where they continue on to the much expanded inner lip ; this reflection does not coalesce with the recurved canal, but is distinctly separated. Outer lip slightly sinuated medially, variced and heavily reflected, a deep ditch outside, internally twenty longitudinal ridges, sharp and separated, run into the mouth a little way ; posteriorly a few dots are intercalated.

Dimensions.—Length 55 mm., breadth 35 mm.

Distribution.—Western Australia.

Remarks.—This species resembles *Cassis exarata* Reeve[15] but differs in smaller size, less nodulation on early whorls and shoulder, and presence of longitudinal lirae, and lacks the color scheme of Reeve's species.

Genus XENOPHALIUM, *nov.*

This name is introduced with the species here described as *X. hedleyi* as type, a second member being the species described by me as *Cassidea royana.*[16]

The large size with the open unarmed mouth characterizes the group, which may include *Cassis* (*Bezoardica*) *wyvillei* Watson,[17] which was described from the Philippine Islands, where it was dredged in 100-115 fathoms. The illustration is suggestive, and this alliance is reinforced by the fact that Brazier[18] has recorded the species from Makeira Harbour, San Cristoval, Solomon Islands, an intermediate locality.

XENOPHALIUM HEDLEYI, *sp. nov.*

(Plate xxxi, figs. 4-5.)

Shell very large for the series of Helmet Shells with open mouths, thin, globose oval, spire exserted rather acutely, whorls shouldered, body whorl twice the length of the spire, aperture elongate oval, sculpture of nodules on the shoulder above concentrically striate. Coloration creamy white, longitudinally flamed with orange brown, irregularly arranged as bands, which appear with a purplish tinge on the varix of the outer lip.

Apical whorls slightly damaged, but apparently of the smooth normal Cassid type ; succeeding whorls, seven in number, sculpture beginning as concentric striae, shoulder minutely nodulose, slanting growth lines over-riding the striae. This sculpture persists for two more whorls, then the striae fade away below the shoulder, on which the nodules become more prominent and more widely spaced, while the concentric striae broaden above the shoulder. On the last whorl the postsutural striations are obsolete, the body whorl practically smooth, only large peripheral nodules present. On the antepenultimate whorl fifteen closely packed striae can be counted above the shoulder, none below, but on the preceding whorl ten impressed striae can be counted below the shoulder,

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15 Reeve—Conch. Icon., v, 1848, pl. xii, sp. and f. 32, Sept. Locality unknown. Mus. Cuming.

16 Iredale—Proc. Malac. Soc. (Lond.), xi, 1914, p. 179, fig. in text.

17 Watson—Zool. Rep. Challenger, xv, 1885, p. 408, pl. xiv, f. 13.

18 Brazier—Proc. Linn. Soc. N.S. Wales, (2), viii, 1893, p. 43.

which is ornamented with twenty nodular projections, this number being reduced to twelve on the body whorl, where they are bolder and continue downwards a little as distinct elevated ridges.

The outer lip is recurved but not strongly folded back, an open channel being present behind; this may be due to age. The columella is doubly twisted, a distinct gap being observed between the columellar curve and the reflected area, which is quite smooth. The columellar lobe proceeds backwards so that only a chink is left open, the inner lip continuing across the shell as a fine glaze only. At the tip of the canal there is a minute umbilical perforation. Canal short, recurved, a narrow ill-marked gutter dividing it from the body whorl, this gutter continuing into the false umbilicus.

Dimensions.—Length 151 mm., breadth 92 mm.

Distribution.—5 miles off Kiama, New South Wales, in 70 fathoms. (Captain J. W. Smith).

Remarks.—Separated from *C. royana* Ire. (*supra*) by its tenuity, its less exert spire, its more numerous and less bold nodulation, and less swollen body whorl.

Genus SEMICASSIS *Mörch.*

1852. *Semicassis* Morch, Cat. conch. Yoldi, pt. i, p. 112, *ex* Klein, species included, *japonica* Reeve, *saburon* Ad., etc. Type, by subsequent designation, Harris, Cat. Tert. Moll. B.M., pt. i, 1897, p. 198, *Cassis japonica* Reeve; by Cossmann, Essais de Paleoconch. comp., livr. 5, 1903, p. 125, *Buccinum saburon* Linné.

1888. *Faurotis* Jousseaume, Mem. Soc. Zool. France, i, p. 188. Type, by original designation, *F. faurotis*, id., Red Sea (and *F. bisulcata* Sow. (*Cassis*)); there is no such species, but there is a *bisulcata* Schubert and Wagner).

1890. *Echinophoria* Sacco, Mem. del. Real. Accad. Sci. Torino, (2), xi, (I. Moll. test. tert. Piemonte and Liguria, pt. vii), p. 39, for *E. isselii* Sacco, and *Bucc. intermedium* Brocchi. (*Cf.* Cossmann, *loc. cit.*, who cites as synonym of *Semicassis.*)

1909. *Bezoardica* Dall, U.S. Geol. Survey, Prof. Paper 59, p. 62. (Not of Schumacher.)

As already shown, *Bezoardica* Schumacher is an absolute synonym of *Phalium*, being coequal and having the same type by virtual tautonymy and also by designation. Dall suggested that as two sections had been provided at its introduction, and as the first section was typified by the type of *Phalium*, the name could be transferred to the second section, and thus displace *Semicassis*, a conclusion that does not need discussion.

Faurotis was introduced by Jousseaume for a shell from the Red Sea, which he described under the name *F. faurotis*, but did not figure. The only clue he gave was that *F. bisulcata* (Sow.) (*Cassis*), was closely related. There is only one *bisulcata* in *Cassis*, that belonging to this series, and the authority is Schubert and Wagner.

Echinophoria of Sacco was synonymised by Cossmann with *Semicassis*, as he considered that the nodulose species intergraded with non-nodulose ones, but this is not found in connection with the recent species. The recent *Casmaria torquata* Reeve does not appear to be related.

SEMICASSIS DIUTURNA, *sp. nov.*

(Plate xxxii, fig. 9.)

1873. *Semicassis saburon* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 837. Northern New South Wales.

1876. *Semicassis pila* Brazier, Proc. Linn. Soc. N.S.W., i, p. 234. Darnley Island, Torres Strait, 20 fathoms.

1885. *Cassis saburon* var. *pila* Tryon, Man. Conch. (i), vii, p. 275. China; Philippines; Australia.

1885. *Cassis* (*Semicassis*) *pila* Watson, Zool. Rep. Challenger, xv, p. 407. Port Jackson, N.S. Wales, 2-10 fath.; West of Cape York, Station 188, 28 fathoms; Philippine Islands, 12-20 fathoms.

1910. *Cassidea pila* Hedley, Rep. Austr. Ass. Adv. Sci., Brisbane, 1909, p. 361. Queensland.

1918. *Phalium pila* Hedley, Check List, p. M. 67, *in* Journ. Proc. Roy. Soc. N. S. Wales, li (1917). N.S. Wales.

Shell medium for the group, ovate, thin, spire short, less than half the length of the body whorl, whorls not shouldered nor tabulate, sculpture consisting of closely packed, flattened, concentric ridges, aperture rather narrowly ovate.

Coloration dull white, four or five concentric rows of yellow squarish blotches may be seen indistinctly on the body whorl. Apical whorls worn, succeeding whorls five in number, the earliest one showing five flat-topped ridges with slanting longitudinal threads between, the succeeding whorls having more ridges and the threads becoming less distinct, so that on the body whorl the narrow intervals between the ridges appear to be punctate only. Ten ridges can be counted on the penultimate whorl, and thirty-five ridges on the body whorl. Canal short, recurved, a very narrow, deep, well-defined gutter behind it, travelling into the deep, narrow, false umbilicus, while the termination of the canal itself bears a rather wide perforation, the tongue-like process being sculptured as the main shell. Columella nearly straight but strongly wrinkled, wrinkles broken towards the edge of the columellar lobe, which is nearly straight and thickened. Inner lip extending on to the body whorl, and appearing as a thick glaze reaching across to the outer lip in senile examples. Outer lip descending rather steeply and meeting the canal directly below the columella, and bearing twenty to twenty-five prominent elongate teeth fairly evenly spaced, a little crowded anteriorly.

Dimensions.—Length 69 mm., breadth 47 mm.

Distribution.—Port Stephens (type), Nambucca Heads, New South Wales; Stradbroke Island, Caloundra, Forsyth Island, Cape Sidmouth, Queensland.

Remarks.—Specimens from Anson Bay, Northern Territory, and Cape Sidmouth, Queensland, differ in their smaller size, narrower build, and heavier varix on the outer lip, the lirae also being fewer in number and consequently broader, These may represent a distinct species. In the latter specimen the apex is preserved and is of the normal, many-whorled, smooth Cassid type. Specimens from Forsyth Island have slightly narrower mouths but similar narrow ribs, while from New Guinea two distinct forms have been sent, one like the present one, the other boldly

marked with yellow square blotches, the body whorl smoother, the mouth more cramped, the varix very heavy.

As the name *Phalium pila* Reeve has been used for this species the status of that name must be discussed. In August, 1848, Reeve[19] included *Cassis saburon*, citing " Le Saburon Adanson. *Cassidea saburon* Brug., Lam., etc.," for a species from " Japan (on the sands) Dr. Siebold," commenting " Martini has a very excellent figure of this species (Conch. Cab., vol. 2, pl. 34, f. 350), referred to by Lamarck under the head of *C. granulosum* (*C. inflatum*), and the figure in a vignette, f. 1, 2 at p. 10 of the same work, to which Mr. Deshayes refers for *C. saburon*, appears to correspond with one not hitherto described, which I propose to distinguish by the name *C. pila*." Martini (p. 30) noted that the largest specimens came from the West Indies, the most beautiful specimens from Ceylon, while some came from the Mediterranean. In the following month Reeve figured and described his new species *C. pila* from China, but the name must be considered in connection with the earlier usage, and West Indies being selected as the type locality, the name cannot possibly be used for the present species.

As an alternative name *C. bisulcata* Schubert and Wagner has been suggested, but this is also inacceptable. These authors[20] described their species as " laevi " ; " anfractibus margine superiore bisulcata," quoting also " List. Tab. 1012, fig. 76," while their own figures show a more globose shell, differently coloured to the Australian species. No locality was known, and the citation of Lister again suggests the West Indian species. As a matter of fact, the figures of the succeeding species, *C. pomum*, f. 3084-3058, resemble more our species, but the words " crassa," " columella inferne interrupta rugosa," and the heavy columellar reflexion indicate the West Indian species.

Genus CASMARIA *H. and A. Adams.*

1853. *Casmaria* H. and A. Adams, Gen. Rec. Mollusca, i, p. 216, for, *achatina, pyrum, vibex*, etc. Type, by subsequent designation, Harris, Cat. Tert. Moll. Brit. Mus., pt. i, 1897, p. 200. *Buccinum vibex* Linn. (Type, by Cossmann, Essais de Paléoconch. livr. 5, 1903, p. 127 : *pirum* Lam.)

1888. *Casmeria* Jousseaume, Mem. Soc. Zool. France, i, p. 190. Type, by monotypy, *Cassis torquata* Reeve.

Small, including the smallest shells for the group, with the mouth somewhat open, but, sometimes with the outer lip scarcely variced, or a very heavy varix is formed ; in each case prickles are formed anteriorly, sometimes for the full length of the lip, rarely are they obsolete. Some forms are smooth, others are nodulose ; the false umbilicus closed.

CASMARIA ERINACEUS (*Linné*).

1758. *Buccinum erinaceus* Linné, Syst. Nat., Ed. x, p. 736, based on " Rumph. mus., t. 25, f. 7. Gualt. test., t. 39, f. I. D. Argenv. conch., t. 17, f. G. Habitat in O. Americano."

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[19] Reeve—Conch. Icon., v, 1848, pl. v, sp. and fig. 11.

[20] Schubert and Wagner—Conch. Cab. (Martini and Chemnitz), xii, p. 68, pl. 223, fig. 3081-3082.

1798. *Cassis denticulata* Bolten, Mus. Bolten, pt. ii, p. 32, based on " Martini, 2, t. 35, f. 363."

1817. *Buccinum meles* Dillwyn, Descr. Cat. Rec. Shells, ii, p. 599, *ex* Solander MS., based on " Martini ii, t. 35, fig. 363."

1848. *Cassis vibex*, var. *B.*, Reeve, Conch. Icon., v, Cassis, pl. vii, figs. 15 a and d.

Distribution.—North Queensland ; extra-limital.

Remarks.—The relationships of the species of *Casmaria*, as here restricted, are puzzling, and their nomination is entangled. Thus Linné published two species of *Buccinum* in the 10th edition of his " Systema Naturae," the first named *erinaceus*, being based on three references all referring to a nodulose shell, while succeeding was another species, *vibex*, in connection with which five figures were cited, the first, a somewhat indeterminate nodulose shell, the others all relating to a smooth one. For many years these have been regarded as being variations of one species, commonly known as *vibex*, and when the variety was named it was quoted as " *vibex* var. *erinaceus*." This was quite wrong, the legitimate form to be used being reversed, but here the forms are regarded as distinct species ; if they are lumped the specific name must be *erinaceus*.[21]

When Hanley commented on the Linnean species he stated that the shells in the Linnean cabinet agreed with the conventional interpretation, but curiously enough he referred to this species as *Cassis vibex* var. *erinaceus*, and added " I do not consider the *Cassidea erinaceus* of Bruguière identical ; it is the *B. biarmatum* of Dillwyn (Schröter, Einl. i, pl. 2, f. 9, Seba, pl. 53, f. 11, 29), and judging from the figure in the Conchologica Iconica (Cas. f. 1 c.) the plaited form of the *C torquata* of Reeve." The larger smooth shell with a thin outer lip contrasts strangely with the smaller, more solid, nodulose, shell with a very crass outer lip, and the latter would be called *erinaceus*, which has priority, while the smooth shell, variety or species, would bear the name *vibex*. When Hedley included *vibex* in the Queensland list he regarded these as varieties only, and the specimens before him were of the *erinaceus* type, but this Museum has since received specimens from Darnley Island which are typical *vibex*, so that Brazier's record from that locality would be also of that type.

CASMARIA VIBEX (*Linné*).

1758. *Buccinum vibex* Linné, Syst. Nat., Ed. x, p. 737, based on " Bonan. recr. 3, t. 152 (seminodulose). Rumph. mus., t. 25, f. E, 8, 9 (smooth) ; Gualt., test., t. 39, f. L. F (smooth) ; Argenv. conch., t. 17, f. H (smooth) ; Kratzenst. Regenf., t. 10, f. 40 (smooth). Habitat ad Jamaicam."

1797. *Buccinum panthera* Solander, Humphrey, Museum Calonnianum (May 1), p. 19. ?New name for *Buccinum vibex* Linné.

1798. *Cassis glabra* Bolten, Mus. Bolten, pt. ii, p. 32, based on " List. 1013, f. 77."

1876. *Casmaria vibex* Brazier, Proc. Linn. Soc. N.S. Wales, i, p. 234. Darnley Island, Torres Strait, 5 fathoms, sandy mud.

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[21] Linne—Syst. Nat. Ed., x, 1758, p. 736, based on " Rumph. mus., t. 25, f. 7. Gualt. test., t. 39, f. I. D. Argenv. Conch., t. 17, f. G. Habitat in O. Americano."

1910. *Cassidea vibex* Hedley, Rep. Austr. Ass. Adv. Sci., Brisbane, 1909 p. 361 (part). Queensland.

Distribution.—North Queensland ; extra-limital.

CASMARIA PONDEROSA (*Gmelin*).

1791. *Buccinum ponderosum* Gmelin, Syst. Nat., pt. vi, 3477 ; based on " List. Conch., t. 1016, f. 74." Habitat ?

1791. *Buccinum nodulosum* Gmelin, Syst. Nat., pt. vi, p. 3479 ; based on " Schroet. Einl. in Conch., i, p. 383, t. 2, f. 9." Habitat ?

1807. *Phalium quadratum* Link, Beschr. Nat. Samml. Rostock, iii, p. 113, based on " Conch. Cab., ii, pl. xxxviii, fig. 385-386."

1817. *Buccinum biarmatum* Dillwyn, Descr. Cat. Rec. Shells, ii, p. 599 ; new name for *B. nodulosum* Gmelin, supra.

1817. *Buccinum pantherina* id. ib. *ex* Solander MS., for Martini, Conch. Cab. iii, t. xxxviii, f. 383-386.

1848. *Cassis torquata* Reeve, Conch. Icon., v, sp. and fig. 1, pl. i, August, 1848. New Holland.

1873. *Semicassis* (*Casmaria*) *torquata* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 838, May, 1873. Macleay River, N.S. Wales.

1910. *Cassidea nodulosa* Gmelin, var. *torquata* Hedley, Rep. Austr. Ass. Adv. Sci., Brisbane, 1909, p. 361. Queensland.

1918. *Phalium torquatum* Hedley, Check List, p. M. 67, *in* Journ. Proc. Roy. Soc. N.S. Wales, li (1917). N.S. Wales.

Distribution.—Queensland ; New South Wales ; extra-limital.

Remarks.—Here again a smooth and a nodulose form are known, but in this case they seem to be inseparable and are commonly found together. They do not appear to be easily distinguished from *C. erinaceus* save by their smaller size and denticulate outer lip. Commonly known as *C. torquata* Reeve, that name seems to have little claim on the score of priority alone. It may be that geographical variation exists, but such has not yet been determined.

The name here utilized appears to have been neglected, but it is based on an easily recognizable figure showing the salient features of the species. Gmelin introduced the name, *B. nodulosum,* for Schroeter's figures, and Dillwyn altered the name to *biarmatum* as there were two species named *nodulosum* by Gmelin, but he preserved the wrong one. When Dillwyn made the emendation, he observed " it may be at once known by its having the inside as well as outside of the outer lip muricated." This is the very feature emphasized by Lister and recorded by Gmelin for his *ponderosum,* which Dillwyn allotted to *erinaceus.* In 1823 Dillwyn referred to this association with some doubt.

Hanley referred to Dillwyn's species as " the plaited form of the *C. torquata* Reeve," and Hedley catalogued the smooth form as *C. nodulosa* var. *torquata.* However, the smooth and nodulose forms were figured in Martini's " Conchylien Cabinet," Bd. ii, where on t. xxxviii, figs. 383-4, are nodulose, and figs. 385-386 are smooth. To the latter, Link assigned the name *quadratum* and Mörch [22] made use of this citing *torquata* as a synonym. Consequently, if the variety be recognized by name it would be called *C. ponderosa* var. *quadrata.*

[22] Mörch—Catalogus Conchyliorum Yoldi, 1852, p. 112.

Genus XENOGALEA, *nov.*

This name is introduced for the species associated with *pyrum* and *labiata* in Neozelanic and southern Australian waters. Many species appear to have evolved in comparatively recent times and no series of fossils is yet known. They are characterized by their small to medium size, open mouth, rarely denticulate within, and short spire. The ornament of the juvenile is more or less reticulate, the adult more or less smooth, with sometimes a nodulous, or even a keeled, shoulder. The variation is not yet well understood as there appears to be geographical variation in only a slight degree, while little bathymetrical variation can yet be determined. Moreover, while the species are easily distinguished, specimens are met with that would suggest intergradation, which, however, does not occur. The genotype will be *Cassis pyrum* Lamarck as here interpreted.

XENOGALEA PYRUM (*Lamarck*).

(Plate xxxii, figs. 14, 16.)

1822. *Cassis pyrum* Lamarck, Hist.Anim. sans Verteb., vii, p. 226 August, 1822. " . . . les mers de la Nouvelle Hollande "=south Tasmania.

1835. *id.* Kiener, Coquilles Vivants, Casque, p. 39, pl. xiii fig. 25; not fig. 30, var.

1867. *Cassis pyrum* Angas, Proc. Zool. Soc. (Lond.), 1867, p. 197. New South Wales, Tasmania, New Zealand.

1873. *Semicassis* (*Casmaria*) *paucirugis* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 838. Merimbula, N.S. Wales.

1877. *Semicassis paucirugis* Angas, Proc. Zool. Soc. (Lond.), 1877, p. 183. Twofold Bay, N.S. Wales.

1889. *Cassis pyrum* Brazier, Proc. Linn. Soc. N.S.W, (2), iv, p. 747. Merimbula, N.S. Wales.

1900. *id.* Pritchard and Gatliff, Proc. Roy. Soc. Vic. (n.s.), xii, 1899, p. 189. April, 1900. Victoria.

1901. *Semicassis pyrum* Tate and May, Proc. Linn. Soc. N.S. Wales, xxvi, p. 373. Tasmania.

1924. *Phalium pyrum* Iredale, Proc. Linn. Soc. N.S. Wales (includes *paucirugis*, *nivea* and *tumida*), xlix, p. 254. N.S. Wales.

Shell medium, thin, solid, globose, spire very short, not attenuate, much less than half the length of the body whorl, whorls semi-shouldered, the shoulder more or less nodulose, sculpture of earlier whorls reticulate, aperture broad, reverse, ear-shaped, outer lip variced, not folded back, internally smooth. Coloration yellowish or brownish white, irregularly banded with squarish blotches of pinkish red of various shades, sometimes unicolor. Apical whorls normal, generally worn but clearly seen in immature specimens; adult whorls five, the earlier ones tabulately shouldered, a nodulose keel being present, fine spiral lines above, almost smooth below the keel. Slanting longitudinal threads cross the spirals causing a faint reticulation; the post-sutural lines persist on to the body whorl, where three to five are fairly prominent; the shoulder bears about sixteen well marked nodules. The body whorl smooth save for a few

spiral grooves around the base, though longitudinal slanting growth lines may also be discerned.

Canal short, recurved, preceded by a narrow gutter running into the false umbilicus, which is wide and open. Columella with a deep notch, sinuated posteriorly but almost smooth, and reflected into a strong, flattened, smooth lobe, expanding across the body whorl to the posterior angle of the aperture as a plate, and leaving no umbilical perforation anteriorly. Outer lip variced, recurved but not flattened, internally smooth.

Dimensions.—Length 56 mm., breadth 39 mm.

Distribution.—Tasmania, Victoria, southern New South Wales, New Zealand.

Remarks.—The Tasmanian specimen figured and described agrees very closely with Kiener's figure of the Lamarckian shell, and differs from the Neozelanic form of the species. A normal Tasmanian shell is also figured, the Neozelanic form being dealt with in an essay by Mr. H. J. Finlay which will appear in the "Transactions of the New Zealand Institute" almost simultaneously.

A little variation may be noted, the nodulose shouldering becoming sub-obsolete or even emphasized, while in rare cases, probably through injury, the outer lip may show a denticulate inner edge. It is a dweller in the shallow water adjoining the littoral, and is generally found as a dead shell washed upon beaches; it is also rarely trawled, the deeper water providing a related species.

Reeve's[23] interpretation of *Cassis pyrum* Lamarck was a very wide one, including *C. zeylanica* Lam., which he figured. The latter species had been carefully discriminated by Lamarck himself. Matters were more complicated by Tryon, who placed everything at sight under *achatina*, allowing *pyrum* varietal rank with *paucirugis*, *zelanica*, *striata*, and *nivea* as synonyms. Such action misled local workers, and has been a source of error ever since.

The true *pyrum* appears to have been collected by Peron and Lesueur, probably in south Tasmania, along with *C. semigranosa*, which was described at the same time. The curious recurrence of the species in Neozelanic waters is worthy of note, as otherwise it appears to be restricted to the Maugean Region, appearing outside only as a straggler, or new resident. Though fossil relatives are known in connection with the Neozelanic form, so far little direct knowledge is known of its forbears on the Australian continent.

As regards the South African forms, Bartsch[24] included *Cassis achatina* Lamarck, *Cassis zealanica* Lamarck, and *Cassis pyrum* Lamarck, but many years before, Martens[25] had introduced a *Cassis pirum* var. *intercedens* for a form from Algoa Bay, though he also allowed *C. pirum* and *C. achatina.*

The South African forms, though superficially resembling the Australian shells, are easily separable, and it may be worth notice that the Western Australian shells are quite unlike.

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[23] Reeve—Conch. Icon., v, September, 1848, pl. x, fig. and sp. 29, a, b, c.
[24] Bartsch—U.S. Nat. Mus. Bull., 91, 1915.
[25] Martens—Wiss. Ergebn. Deutsch. Tiefsee Exped., vii, 1903, pp. 54-56.

CASSIS TUMIDA *Petterd.*

1886. *Cassis tumida* Petterd, Pap. Proc. Roy. Soc. Tasm., 1885, p. 321.

The description reads " Shell thick, white, dull, globose, marked with a few prominent lines of growth ; whorls, 5 ; rounded, minutely, regularly, transversely lirate ; spire, small, short, rather acute, apical whorls, smooth, suture emarginate, callus deposit, thin, striate, and shining ; aperture ovate, inflated ; outer lip, sub-reflexed, and slightly prominently thickened outside. Long.—30 mill. Lat.—18 mill. Habitat.—Near River Leven (Miss Lodder)."

There is a specimen from Frederick Henry Bay, south Tasmania, presented by Mr. W. L. May, who has studied Petterd's type, and this, while agreeing with the description, proves to be an immature specimen of one of the species.

Pritchard and Gatliff[26] definitely state that *C. tumida* Petterd is a young immature shell of *pyrum.*

XENOGALEA STADIALIS (*Hedley*).

(Plate xxxi, fig. 3.)

1914. *Cassidea stadialis* Hedley, Biol. Results, F.I.S. " Endeavour," ii, February 2, 1914, p. 72, pl. x, fig. 4. Between Green Cape and Gabo Island, 50-100 fathoms.

1902. *Cassidea turgida* Hedley, Mem. Austr. Mus., iv. July 29, 1902, p. 340, pl. xxxvi, fig. 1. Off Wollongong, 55-56 fathoms and off Botany Bay, 79-80 fathoms, New South Wales, 100 mm. long.

1902. *Cassidea recurvirostrum* id. , ib. , p. 341, Off Cape Three Points, 41-50 fathoms, New South Wales, 50 mm. long.

1916. *Cassis achatina* var. *stadialis* Gatliff and Gabriel, Proc. Roy. Soc. Vict., xxix, (n.s.) p. 108, October, 1916. Dredged in Bass Strait.

1918. *Phalium stadiale* Hedley, Check List, p. M. 67 *in* Journ. Roy. Soc. N.S. Wales, li (1917), N.S. Wales.

This species has been well described so that the essential characters are here simply noted in connection with the variation now known. The species is a deep water relative of *pyrum*, not of *labiata*, and typically is very large and globose, without shouldering or nodulation.

It is now a well known inhabitant of the continental shelf of New South Wales, living in the deeper waters from 50-100 fathoms. In the depths between 25-50 fathoms a smaller form occurs, which has the last whorl shouldered, the shoulder semi-nodulose. In series trawled these are often met with together, inhabited by hermit crabs, so that they may represent different forms, the smaller shell being a direct relation of *pyrum*, the larger a more differentiated relative. Both are relations of *pyrum* through the characters of the columella, which differs in that species from that of *labiata*, to which the present species has been referred through a deceptive resemblance.

Besides the New South Wales localities, this species has been recorded from Bass Straits by Gatliff and Gabriel ; two specimens from deep water between Gabo and Flinders Island belonging to the small form ; while

[26]Pritchard and Gatliff—Proc. Roy. Soc., Vict., n.s., xii, 1899 (April, 1900), p. 189.

another from off Devonport, north Tasmania, which, whilst agreeing with *stadialis* in shape, is more solid, and seems a direct shallow water form of the true *pyrum*. Still another shell from Tasmania, apparently a beach specimen, is superficially a large, smooth, unicolor *stadialis*, though just as certainly a *pyrum* form.

Many years ago Reeve[27] described *Cassis turgida* as a new species which Cuming had collected at the Island of Zebu in the Philippines, but observed "belonging to the same group as *C. achatina, vibex, torquata.*" The same shell seems to have been figured by Sowerby in his "Conchological Manual," first edition, figure 411. The association of the species with the name *achatina* was sufficient to induce Tryon to regard it as a synonym, an erroneous conclusion.

Watson[28] recorded *Cassis* (*Casmaria*) *turgida* from the Admiralty Islands, north east of Papua, 16-25 fathoms, and probably through this reference Hedley used the name for an Australian species which he subsequently named *stadialis*.

Xenogalea finlayi, *sp. nov.*

1924. *Cassidea stadialis* Finlay, Trans. New Zeal. Inst., iv, p. 525, pl. lii, figs. 3, a, b, c. Off Otago, New Zealand, 20 fathoms.

The shell figured and described by Finlay under the above name is easily separable from the Australian species by its more globose form, and is here named as a new species. The Neozelanic forms that have been confused under the names *pyrum, labiata, achatina*, etc., will be dealt with in a paper by Finlay to be published subsequently. I am anticipating this account only for the purpose of allotting the name of my friend and collaborator to this beautiful species as a mark of distinction and respect. The revolution in Neozelanic systematic conchology, now in progress, is mainly due to his enthusiasm and careful study of the recent and fossil forms in conjunction.

Xenogalea thomsoni (*Brazier*).

(Plate xxxii, figs. 6, 7.)

1875. *Cassis* (*Casmaria*) *thomsoni* Brazier, Proc. Linn. Soc. N.S. Wales, i, p. 8 (May, 1875). On sandy bottom, 45 fathoms, five miles due east of Sydney Heads ("Challenger.")

1889. *Cassis thomsoni* Whitelegge Journ. Proc. Roy. Soc. N.S. ., xxiii, p. 257. Off Port Jackson.

1902. *Cassidea pyrum* var. *thomsoni* Hedley, Mem. Austr. Mus., iv, July 29, p. 341, pl. xxxv, figs. (type) 2, 3. Off Cape Three Points, 41-50 fathoms. N.S. Wales.

1914. *Cassidea thomsoni* Hedley, Biol. Results, F.I.S.* "Endeavour," ii, p. 73, February 2. Between Green Cape and Gabo Island, 50-100 fathoms. N.S. Wales.

1918. *Phalium thomsoni* Hedley, Check List, p. M. 67 *in* Journ. Roy. Soc. N.S. Wales, li, 1917. N.S. Wales.

Shell medium, thin, fragile, globose, spire short, attenuate, less than

[27] Reeve—Conch. Icon., v, September, 1848, pl. x, sp. and fig. 25, a. b, c.
[28] Watson—Zool. Rep. Challenger, xv, 1885, p. 409.

half the length of the body whorl; whorls angulately shouldered, sculpture on early whorls finely reticulate, body whorl smooth, aperture large, broadly reverse ear-shaped, outer lip variced, varix recurved, internally with only faint indications of teeth.

Coloration pinkish fawn with spiral bands of square red brown blotches, darker colored on the shoulder.

Apical whorls smooth, first two almost planate, succeeding two rapidly increasing, globose and a little tilted; succeeding whorls five, first adult whorl with half a dozen spiral ridges crossed by about fifty longitudinal slanting threads; on third adult whorl a shoulder develops which on the next is crenulated by the threads, becoming obsolete on the last whorl. Above the shoulder the threads increase in number and the median ones in strength; below the shoulder they become more distant and weaker, disappearing on the middle of the body whorl but remaining as ridges on the base. Generally on the last whorl below the shoulder a depression occurs and a second angulate ridge appears.

Canal short recurved, preceded by a rather broad gutter running into a fairly deep false umbilicus. Snout turned back but short, an umbilical chink present; columella wrinkled, wrinkles more pronounced internally, eight notable ones being counted, continued on reflected expanded inner lip, which is sinuate and seen as a white glaze on body whorl. Aperture comparatively wide, anteriorly the outer lip is produced below the columella and with a full sweep joins the body whorl just below the angulate shoulder, internally the outer lip is smooth, a few denticles appearing with age.

Dimensions.—Length 49 mm., breadth 34 mm. Type. Length 56 mm., breadth 39 mm.

Distribution.—New South Wales: off Cape Three Points, off Sydney, off Botany Heads, off Montague Island, off Twofold Bay, off Green Cape, in water from 30 to 70 fathoms deep: on beaches at Broken Bay and Port Stephens.

Remarks.—Generally distributed on the continental shelf of New South Wales, this species occurs with *stadialis* but is a thinner shell. The type, here figured, is a small, strongly sculptured shell, so a normal adult specimen is also depicted.

XENOGALEA SOPHIA (*Brazier*).

(Plate xxxii, fig. 12.)

1872. *Cassis sophia* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 617, pl. xliv, f. 2, November 3. Near Grassy Head, mouth of Macleay River, New South Wales.

1873. *Semicassis* (*Casmaria*) *sophiae* Brazier, ib., p. 838.

1910. *Cassidea pyrum sophiae* Iredale, Proc. Malac. Soc. (Lond.), ix, p. 71. Kermadec Islands.

1915. *Cassidea pyrum* Oliver, Trans. New Zeal. Inst., xlvii, 1914 (1915), p. 529. Kermadec Islands.

1918. *Phalium sophia* Hedley, Check List, p. M. 67 *in* Journ. Roy. Soc. N.S. Wales, li (1917). N.S. Wales.

Shell large for this genus, globose, thin, spire short, whorls tabulate, spire less than half the length of the body whorl, aperture oval, reverse

earshaped, sculpture of impressed lines only, the body whorl tending to smoothness. Coloration almost ivory white, ornamented with spiral rows of large square orange blotches, ten blotches to a row, five rows on body whorl, the lower two appearing only near varix where they are seen as bands on edge. Apical whorls worn down, five adult whorls present, the earlier sculpture being flattened ridges, two on the flattened shoulder, three below, these becoming more obscurely marked on the latter whorls. On the penultimate whorl one obsolete ridge is noticed below and there are two distinct ridges on the shoulder ; the body whorl shows the continuation of these two, with the suggestion of a third, on the flattened shoulder. Below the shoulder half a dozen ridges are obscurely imaged through a smoothened surface, and basally another half dozen are seen well impressed.

Canal short recurved, the anterior gutter well defined and bounded by a raised edge as it enters the narrow false umbilicus ; there is an open umbilical perforation.

Columella folded and irregularly wrinkled, the folds with a prominent ridge, eight wrinkles being counted on this area ; columellar lobe very large, strongly reflected ending in a curve, and continuing as a thin glaze across the body whorl, the colour blotches showing through.

Outer lip anteriorly narrowed, then sweeping widely, almost joining the body whorl posteriorly at a right angle ; varix reflected, but not folded over, and bearing internally eighteen elongate, somewhat distantly placed ridges, crowded a little anteriorly and becoming obsolete posteriorly.

Dimensions.—Length 79 mm., breadth 65 mm.

Distribution.—New South Wales, south Queensland, Kermadec Islands.

The type, here described and figured, came from the north coast of New South Wales, but there is in this Museum two specimens collected by Mr. G. Gross at Peel Island, Moreton Bay, south Queensland, which agree accurately. There is also a beautiful specimen trawled in 40-80 fathoms off Green Cape, New South Wales, by Captain J. W. Smith which agrees very closely, the mouth armature not being so pronounced, but this is a variable feature. I have recorded this species from the Kermadec Islands, and the worn specimen agrees very well, but shows no color blotches.

Xenogalea nivea (*Brazier*).

(Plate xxxii, fig. 13.)

1872. *Cassis nivea* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 616, pl. lxiv, fig. 1, November 3, 1872. Macquarie Harbour, west coast of Tasmania.

Shell small, thin, globose, spire very short, whorls shouldered, aperture wide, earlier sculpture of spiral lines which disappear on the body whorl, where a double row of tubercles adorn the shoulder, outer lip recurved, but varix not well formed.

Coloration pure white, rather waxy, outer lip edged with yellow as is columella and part of body whorl in front of aperture.

Apical whorls worn, succeeded by four adult whorls, which show half a dozen spiral ridges on first two, longitudinals obsolete ; on third whorl these are more distant and uneven, and obscure radials may be seen. The

body whorl has a flattened shoulder showing two elevated, round, spiral ridges, a third forming an angulate shoulder sharply cut by a dozen elongated, conical nodules, which do not appear until past the aperture and die away before they reach the outer lip. Below this appears a shallow excavation succeeded by a similar row of nodules, otherwise the body whorl is smooth and only obscure lines are seen basally.

Canal short, rather open, recurved, a broad gutter running into the deep open false umbilicus, but no umbilical chink is retained.

Columella wrinkled a little internally, two major folds present, inner lip expanded but quite smooth.

Outer lip effuse and rounded, thin, recurved but not variced.

Dimensions.—Length 51 mm., breadth 44 mm.

Distribution.—West coast of Tasmania, South Australia.

The type, which is somewhat immature, is described above, but adult shells are present in the Museum from Encounter Bay, McDonnell Bay, and Port Lincoln, South Australia, and these appear to be the species known as "*paucirugis*" from that State; there is also a fine adult shell from Tasmania. All these agree in that they are more solid, with longer spire, outer lip strongly variced, internally strongly lirate, the lirae more pronounced anteriorly, columella strongly wrinkled and wrinkles continuing on the inner lip expansion and moreover strongly marked on the body whorl towards the posterior angle of the aperture. The varix bears the red brown blotches of allied colored species.

XENOGALEA PAUCIRUGIS (*Menke*).

(Plate xxxi, fig. 2.)

1843. *Cassis paucirugis* Menke, Moll. Nov. Holl. Spec., p. 23: western shores of New Holland, but also including *C. pyrum* Lamarck, citing Kiener, fig. 30.

1844. id., Zeitschr. Malak. (Menke), p. 60 (April 10) "... known for many years previously in Germany," and rejecting *C. pyrum* Lamarck.

1848. *Cassis paucirugis* Reeve, Conch. Icon. v, sp. and fig. 19, pl. viii, September. From specimen in Cumings' collection compared with type sent by Menke.

1857. *Cassis paucirugis* Kuster, Conch. Cab. (Martini and Chemnitz), iii, Abth. i, Th. 2, p. 45, pl. liii, f. 6.

1865. *Semicassis* (*Casmaria*) *paucirugis* Angas, Proc. Zool. Soc. (Lond.), 1865, p. 168. "From Swan River to Tasmania."

1912. *Cassidea pyrum* Verco, Trans. Roy. Soc. South Australia, xxxvi, 1912, p. 217. Great Australian Bight, 90-120 miles west of Eucla, 75-120 fathoms.

1916. *Cassidea paucirugis* Hedley, Journ. Roy. Soc. Western Australia, i, 1916, p. 47. W. Australia.

Shell medium, solid, ovate; spire short, somewhat attenuate, less than one half the length of the body whorl; whorls rather acutely shouldered, shoulder less marked on the body whorl; sculpture on the earlier whorls consists of spiral lirae crossed by distant slanting threads, body whorl smooth; aperture reverse ear shaped, ovate; heavy external varix, lirate within. Coloration shining porcelain white, sometimes

with four obscure spiral bands of orange blotches, the varix marked with red to correspond with these rows. Apical whorls worn, succeeding whorls with spiral lirae and slanting longitudinal threads, each growing weaker until they disappear on the body whorl; on the penultimate a few concentric lines may be seen above the shoulder, none below, the shoulder marked by sharp close nodulations, twenty on the penultimate vanishing on the last half of the body whorl. Canal recurved; a short, narrow, deep gutter running into the false umbilicus; this is almost hidden by the reflected columellar lobe, which is very pronounced and passes across the body whorl to the outer lip, showing a prominent little elevation before reaching the posterior angle. Columella wrinkled, and with a noticeable narrow groove anteriorly, wrinkles scarcely extending on to the reflected lobe; an umbilical perforation is present. Outer lip strongly variced, varix folded back, internally markedly lirate, the lirae, about twenty-five in number, being more crowded anteriorly.

Dimensions.—Length 56 mm., breadth 38 mm.

Distribution.—Western Australia.

Remarks.—As far as yet known, this species is restricted to Western Australia, typical dead specimens having been dredged in King George's Sound by Professor W. J. Dakin, while Captain W. Burrows has presented dead shells from Vansittart Bay, north Western Australia, which differ only in the more pronounced denticulation of the outer lip. In the Helms collection in this Museum is a shell with pale square blotches as noted by Reeve. Verco has recorded specimens from 75-120 fathoms in the Great Australian Bight, 90-120 miles west of Eucla under the name *C. pyrum* with the remarks "All were well coronated, with moderately exserted spires and with more or less marked axial plicae on the inflation of the body whorl, a little below the coronation. Some have two spiral bands of orange blotches on the body whorl." This form is apparently related to *paucirugis*, differing in the thinner shell, less exert spire, more open umbilicus, and larger size, the outer lip showing only few denticulations. A very similar shell has been found washed up on the Ninety Mile Beach, Victoria, sent to me by Mr. C. J. Gabriel, and a specimen has recently been trawled off Montague Island, South New South Wales, and secured by Mr. W. Boardman of this Museum.

This species would appear to have been first introduced into literature by J. E. Gray[29] under the name *Cassis achatina* var.

When Menke commented upon the species included in his "Specimen" he observed that, though his *paucirugis* had been known for some years, it had not been previously named. Since then the name has been misapplied to southern and even eastern forms, though these do not resemble the typical shell to any extent.

The name *paucirugis* was used by Bednall for shells I regard as *nivea*, and by Brazier for the true *pyrum*, while by Tasmanian conchologists it was used for both of these species.

Pritchard and Gatliff[30] pointed out that this species was quite distinct, drawing attention to the denticulate outer lip.

[29] Gray—Survey Intertrop. Coasts Austr. (King), ii, "1827," p. 485, [April 18, 1826].

[30] Pritchard and Gatliff—Proc. Roy. Soc. Vic., (n.s.), xii, 1899, p. 189, April, 1900.

XENOGALEA LUCRATIVA, *sp. nov.*
(Plate xxxii, fig. 11.)

1848. *Cassis recurvirostrum* Reeve, Conch. Icon., v, sp. and fig. 16, a, b, pl. vii (Sept.). Raines Island, Torres Strait, Capt. Ince, R.N.
1857. *Cassis recurvirostrum* Kuster, Conch. Cab. (Martini and Chemnitz), Bd. iii, Abth. i, Th. 2, p. 22. "New Holland: My Coll."

Shell medium, thin, ovate, spire a little exsert, about half the length of the body whorl, aperture narrowly ovate, sculpture of the earlier whorls reticulate, body whorl smooth, external varix not recurved back into a fold. Coloration creamy white, banded with orange, the bands irregular, being composed of squarish orange blotches which finally run together. Apical whorls worn, the succeeding ones with spiral lirae, four or five in number, crossed by slanting longitudnal threads, which at first predominate but weaken quickly and disappear on the antepenultimate, while the spirals persist as threads to the penultimate whorl, but also disappear on the body whorl; this is smooth, save for rather prominent growth lines, but under the glass an obscure matt of spirals and longitudinals can be traced.

Columella nearly straight, finely wrinkled, expanded into a lobe which bears separated pimples.

Canal short, recurved, a very narrow deep gutter running into the rather wide false umbilicus, while an open perforation is apparent at the tip of the canal.

The outer lip is a little expanded, the varix recurved but not folded, and the internal teething consists of about twenty separately spaced lirae.

Dimensions.—Length 63 mm., breadth 40 mm.

Distribution.—North Australia, Raines Island, Torres Strait.

Remarks.—Reeve did not propose his name for a new species, but simply used *Buccinum recurvirostrum* as of Wood,[31] whose name was given to "List. Conch., t. 1016, f. 75," from Barbadoes.

Kuster[32] quoted the species as of Wood, and cited "Lister, fig. 74," but that figure refers to a small shell "crassum et ponderosum" which is quite unlike; fig. 75, described as "ventricosum tenue Barbad.," is the one which should have been named, and is the one named by Wood, agreeing with the basis of Gmelin's[33] species.

Again, even Gmelin's name is unstable, as Mörch[34] preferred *cicatricosa* Meusch., 1871, 303, pl. xix, f. 1, 2. Reference to the "Zoophylacium Gronovianum" shows an excellent figure of this species, and the "Iconographia sive Tabularum Explicatio," of that work, including 'Tabula xviii, seu Fascic, iii. Tab. i,' 'Tabula xix, s. Tab. ii,' and 'Tabula xx, s. Tab. iii,' in which the names are given binomially, and also in the Index as noted under *C. spinosa* (*ante*, p. 327) the name *cicatricosa* occurs.

XENOGALEA LABIATA (*Perry*).
(Plate xxxi, fig. 1.)

1811. *Cassidea labiata* Perry, Conchology, pl. xxxiv, fig. 1 (April 1). "South Seas," probably Sydney, N.S. Wales.

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[31] Wood—Index Test., 2nd ed., 1828, p. 105, pl. xxii, f. 30.
[32] Kuster—Conch. Cab. (Martini and Chemnitz), Bd., iii, Abth., i, Th. 2, p. 22.
[33] Gmelin—Syst. Nat., pt. vi, p. 3477, 1791.
[34] Mörch—Catalogus Conchyliorum Yoldi, 1852, p. 113.

1816. *Cassis achatina* Lamarck, Tabl. Ency. Meth. Vers, vol. i; Liste, p. 3, pl. 407, f. 1, a, b.
1822. id., Hist. Anim. sans Verteb., vii, p. 226 (August). " les mers de la Nouvelle Hollande."
1828. *Buccinum achatinum* Wood, Index Testac., 2nd ed., p. 105, pl. xxii, fig. 22. New Holland.
1835. *Cassis achatina* Kiener, Coquilles Vivants, Casque, p. 37, pl. xiii, fig. 24.
1867. *Cassis achatina* Angas, Proc. Zool. Soc. (Lond.), 1867, p. 196. N.S. Wales, S. Africa.
1873. *Semicassis* (*Casmaria*) *achatina* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 838.
1902. *Cassidea labiata* Hedley, Proc. Linn. Soc. N.S. Wales, xxvii (Aug. 22), p. 27.
1911. *Cassidea achatina* Shirley, Proc. Roy. Soc. Queensland, xiii, p. 98. Caloundra, Queensland.
1918. *Phalium labiatum* Hedley, Check List, p. M. 67 *in* Journ. Roy. Soc. N.S. Wales, li (1917). N.S. Wales.

Shell glossy, small, medium, thin but strong, oval, spire short and less than half the length of the body whorl, which is not at all shouldered, aperture narrowly ovate, external varix heavy, folded back, denticulate within, teeth more pronounced anteriorly. Coloration distinctive, earlier whorls bluish lilac, a few subsutural square spots of reddish brown, irregular longitudinal flames of a similar shade developing, interrupted by a median spiral band of the same colour, the last whorl showing as many as seven of these bands, the intervening markings varying from pale lilac to chocolate, appearing as pale scalloping. The coloration is interrupted by a cream elevated blotch in front of the posterior angle of the aperture, the columellar reflection being also cream. The inside of the mouth is deep lilac, the external margin marked with chocolate bands.

Apical whorls normal, succeeding whorls five, earlier ones with fine spiral threads, later ones becoming smooth, shining, and showing faint growth lines only.

The columella is internally plicate, a deeper sulcation anteriorly, the columellar expansion smooth and abruptly incurved, almost covering the false umbilicus, leaving only a small umbilical chink. Aperture narrowly ovate, reverse ear-shaped, outer lip strongly denticulate, but through fracture sometimes appearing nearly smooth. Canal short, strongly recurved, an indistinct gutter preceding and running into the false umbilicus.

Dimensions.—Length 62 mm., breadth 39 mm. (figured specimen).

Distribution.—New South Wales from Richmond River to Twofold Bay (Bungaree Norah, Broken Bay, Narrabeen, Port Jackson, Bulli, Shell Harbour); South Queensland and Norfolk Island.

Remarks.—Pritchard and Gatliff[35] have recorded *Cassis achatina* from San Remo, Bass Strait, Waratah Bay (Miss Stirling), but I have seen no specimens of the distinctive shell from Victoria. I secured a shell at Port Fairy, Victoria, in 1923 which may be the Victorian representative, but it is larger, less brightly colored, and lacks the distinctive colour

[35] Pritchard and Gatliff—Proc. Roy. Soc. Vict., n.s., xii, 1899, p. 189 (April, 1900).

scheme of the typical form. On the other hand the shell from Norfolk Island agrees very closely in detail with the typical series.

When Reeve[36] included *Cassis achatina* as of Lamarck he observed " Lamarck cites New Holland, but Cuming's specimens (which were figured) were collected at Algoa Bay, South Africa." This error has been perpetuated down to date, though comparison shows the South African shell to differ appreciably, while the Australian species has a very restricted habitat. As related, Tryon's idea of *achatina*, of which he made *turgida* Reeve a synonym, was a very strange one, for he included *pyrum* and others, with a range from the Cape of Good Hope to the Philippine Islands, with outliers at Natal and Cape Verde Islands.

Cassis achatina, or *labiata*, has been commonly ascribed to New Zealand, but always as a rare shell. Apparently to include it in collections, specimens have been secured from Sydney, and one of these appears to be figured by Suter. The true Neozelanic shell is very close to the species here named *insperata*, and will be dealt with in an essay prepared by Finlay and myself, to which reference has previously been made.

XENOGALEA INSPERATA, *sp. nov.*

(Plate xxxi, fig. 8.)

1873. *Semicassis* (*Casmaria*) *pyrum* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 838, May 1873. New South Wales.

1889. *Cassis pyrum* Whitelegge, Proc. Roy. Soc. N.S. Wales, xxiii, p. 257. Port Jackson.

Shell small, medium, thin but strong, globose oval, spire short, much less than half the length of the body whorl, aperture rather narrowly ovate, external varix not folded back, but lirate within, lirae more crowded anteriorly

Coloration pale pinkish white with interrupted lines of elongate white spots, sometimes accompanied by a few larger reddish ones, a subsutural row of reddish brown blotches being present; sometimes the body whorl may show an additional few blotches while the outer lip shows seven to nine dark purplish brown patches which coincide with the spaces between the white lines.

Apical whorls normal, generally worn in adults, five adult whorls, the earlier ones faintly reticulate but becoming smooth on the third; there is no shoulder present until the last whorl, which presents a few coarse nodules towards the outer lip, as many as eight being counted; on the base a few obsolete ridges are faintly discernible.

Canal short, recurved, preceded by a narrow gutter which enters a small false umbilical perforation; columella nearly straight, notched anteriorly and weakly lirate, expanded into a smooth lobe which flattens over the false umbilicus nearly closing it, at the tip a scarcely noticeable umbilical chink, inner lip only seen as a faint glaze over body whorl. Outer lip variced.

Dimensions.—Length 56 mm., breadth 41 mm.

Distribution. —New South Wales (Ballina, Stockton, Port Stephens, Port Jackson, Port Hacking, and Bulli), south Queensland (Caloundra), New Zealand.

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[36]Reeve—Conch. Icon., v, 1848, pl. x, sp. and fig. 28, a, b (September, 1848).

Remarks.—This species has been recorded as *pyrum* but it is more closely related to *labiata*, appearing to be a shallow water relative of that species. The Neozelanic shell, usually referred to as *C. achatina* or *labiata*, is very like this, and not much like the true *labiata*. It will be dealt with subsequently by Finlay.

XENOGALEA ANGASI, *sp. nov.*

(Plate xxxii, fig. 15.)

1911. *Cassidea angasi* Brazier, Shirley Proc. Roy. Soc. Queensland, xxiii, 1911, p. 98 : Caloundra, Queensland (*nomen nudum*).

Shell small, ovate, thin, spire acuminate, more than half the length of the body whorl, aperture narrowly ovate, sculpture of earlier whorls reticulate, body whorl smooth, external varix thick and folded.

Coloration ivory white.

Apical whorls worn, succeeding whorls six, earlier ones shallowly shouldered, the sculpture consisting of lirae overridden by slanting radials, which become less marked until they disappear on the body whorl, the penultimate whorl shows one crenulate and three fine lirae above the slightly sloping shoulder, and two obscurely below.

Canal short, very recurved, preceded above by a deep, narrow, gutter proceeding into the false umbilicus, which is indicated by a deep hollow; three or four lines can be seen above this on the basal part of the body whorl. Columella with a double twist finely wrinkled throughout, reflected into a lobe which does not expand on to the body whorl and which leaves a noticeable opening (the umbilicus) at the termination of the canal. The edge of this opening is reflected, and the columellar snout so formed is striated and callused, behind which an additional perforation is formed. This columellar twisting and reflection is a characteristic feature. The outer lip is variced and heavily reflected ; internally there appear sixteen to eighteen distant lirae evenly separated, but posteriorly smaller teeth intercalate.

Dimensions.—Length 55 mm., breadth 36 mm. Type (Moreton Bay, Queensland).

Distribution.—New South Wales, south Queensland.

Remarks.—A broken specimen from the Richmond River, New South Wales, presented by Mr. A. W. O'Sullivan, obviously represented an unknown species, but in the collection was found the fine specimen here figured, bearing the name "*angasi* Brazier," from Moreton Bay, Queensland. Though the species has not hitherto been described the name has been recorded by Shirley as above, with the locality, Caloundra, Queensland.

Genus ANTEPHALIUM, *nov.*

This genus is provided for the species *Cassis semigranosa* Lamarck, with which is associated *Cassis adcocki* Sowerby and *Cassidea sinuosa* Verco.

All the species are small, ovate, comparatively strongly sculptured, mouth narrow, outer lip recurved, not strongly variced as a rule, columella reflected so as to leave only a minute false umbilicus. All live in southern Australia, and have their closest relations in the fossil forms of Tasmania Victoria, and South Australia.

ANTEPHALIUM SEMIGRANOSUM (*Lamarck*).

1822. *Cassis semigranosa* Lamarck, Hist. Anim. sans Verteb., vii, p. 228 (August, 1822). "les mers de la Nouvelle Hollande" = South Tasmania."

1828. *Buccinum semigranosum* Wood, Index Test., Suppl., ii, pl. iv, fig. 2. No locality.

1835. *Cassis semigranosa* Kiener, Coquilles Vivants, Purpurifères, pt. i, 36, pl. 14, f. 29. Seas of New Holland. Lamarck's type figured.

1848. *Cassis semigranosa* Reeve, Conch. Icon., v, pl. ii, sp. and fig. 3 (August, 1848). Van Diemen's Land.

1857. *Cassis semigranosa* Kuster, Conch. Cab. (Martini and Chemnitz), iii, Abt. i, Th. 2, p. 24, pl. xliv. figs. 6-7. New Holland.

1865. *Semicassis semigranosa* Angas, Proc. Zool. Soc. (Lond.), 1865, p. 168. South Australia.

1877. *Cassis semigranosa* Tenison-Woods, Papers. Proc. Roy. Soc. Tasm., 1876, p. 33. Tasmania.

1885. *Cassis semigranosa* Tryon, Manual Conch., vii, p. 275, pl. iii, fig. 60. South Australia and Tasmania.

1887. *id.* Brazier, Trans. Roy. Soc. S. Australia, ix, 1885-86, p. 123.

1900. *id.* Pritchard and Gatliff, Proc. Roy. Soc. Vict., n.s., xii, 1899, p. 190. Victoria.

1901. *Semicassis semigranosa* Tate and May, Proc. Linn. Soc. N.S. Wales, xxvi, p. 373. Tasmania.

1912. *Cassidea semigranosa* Verco, Trans. Roy. Soc. South Australia, xxxvi, p. 217. Western Bight, 100 fathoms.

1916. *id.* Hedley, Journ. Roy. Soc. W. Australia, i, p. 47. W. Australia.

1921. *Phalium semigranosum* May, Check List Mollusca Tasmania, p. 65. Tasmania.

1923. *id.* Illus. Index Tasmanian Shells, pl. xxx, fig. 2. Tasmania.

Shell small, thin but solid, regularly oval, spire acuminate, more than half the length of the body whorl, aperture narrowly reverse ear-shaped; sculpture of earlier whorls finely semigranose, middle of body whorl smooth, outer lip a little sinuate, varix recurved but not folded back, internally smooth.

Coloration dull brownish white.

Apical whorls three, a little elevated, smooth; adult whorls five, first adult whorl with about eight square-topped spiral lirae over-ridden by very closely packed slanting, radial, threads which strengthen on the next whorl forming square nodules, the antepenultimate whorl

showing five spiral rows of small separated nodules with a depression between the sutural row and the shoulder, which is not very pronounced; the penultimate whorl shows this depression a little more marked, while it is well defined on the body whorl. On this whorl the five rows become ill-defined and the median portion of the whorl smooth save for growth lines, the lirae reappearing on the base but in that place not nodulose. Canal short, much recurved, anterior gutter well marked, the false umbilical opening nearly closed by the columellar expansion. There is no umbilical perforation. Columella with half a dozen strong wrinkles and two major grooves, only expanded a little and closely appressed to the body whorl, where a very thin glaze persists across to the anterior edge of aperture, inside which there is a small white callus lump. Outer lip sinuate medially, advancing posteriorly, thickened and recurved as a varix but not folded back.

Dimensions.—Length 54 mm., breadth 32 mm.

Distribution.—Victoria, Tasmania, South and south Western Australia.

Remarks.—The fossil *S. subgranosa* Tate[37] from the raggy-limestones of Edithburgh, South Australia, is closely allied to the recent shell, as, though the sculpture is at first sight so much bolder, there is great variability in this respect in the recent species. South Australian shells may have short spires and the post-sutural beading obsolete, the nodulose sculpture weak and fading on the body whorl, which is mostly smooth. South Tasmanian shells may have the spire produced, the sculpture bold, a well-developed post-sutural bead row present and a strong nodulose pre-peripheral sculpture on the body whorl, base of which is also spirally lirate. The fossil is comparable with a juvenile of the latter form, the body whorl of which shows spiral lirae throughout.

When Angas recorded the species from South Australia he observed "Specimens from Tasmania, where it is not uncommon, are of a larger size than those found in South Australia."

ANTEPHALIUM ADCOCKI (*Sowerby III.*).

1896. *Cassis adcocki* Sowerby III., Proc. Malac. Soc. (Lond.), ii, p. 14, fig. in text. Yankalilla Bay, South Australia.
1912. *id.* Gatliff and Gabriel, Proc. Roy. Soc. Vict., n.s., xxv, p. 170. Bass Strait.
1912. *Cassidea adcocki* Verco, Trans. Roy. Soc. South Austr., xxxvi, p. 217. 90 miles west of Eucla, Great Australian Bight, 100 fathoms.
1916. *id.* Hedley, Journ. Roy. Soc. Western Australia, i, p. 47. W. Australia.

Shell very small, solid, regularly oval, spire elate, about half the length of the body whorl, aperture narrow, slightly reverse ear-shaped, sculpture of impressed lines overriden by strong radials on shoulder, outer lip heavily variced and internally denticulate.

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[37] Tate—Trans. Roy. Soc. S. Australia, xi, Apl., 1889, p. 166, pl. vii, fig. 10.

Coloration pure white, marked with spiral rows of small bright red-brown square spots, six rows on the body whorl, twenty spots to a row. Apical whorls rubbed down, probably normal; adult whorls three in number, the earlier ones spirally lirate, the lirae crossed by strong slanting longitudinal threads forming a reticulation, the spirals predominating; on the last whorl a sloping shoulder is seen a little excavate, and below it the longitudinals are still strong, forming about twenty short radial ridges, the spirals continuing and still well pronounced on the base.

Canal short, much recurved, preceded by a very narrow deep gutter running into a minute false umbilicus, which is almost hidden by the columellar expansion, though there is a faint umbilical chink. Columella nearly straight, very little wrinkled, though a little expanded. Outer lip heavily variced and folded back, internally toothed, teeth more pronounced posteriorly.

Dimensions.—Length 28 mm., breadth 17 mm.

Distribution.—South Australia, Victoria, south Western Australia.

Remarks.—The exact relationships of this rare little shell are not known, but they may be with the fossil *S. transenna* Tate.[38]

ANTEPHALIUM SINUOSUM (*Verco*).

1904. *Cassidea sinuosa* Verco, Trans. Roy. Soc. S. Australia, xxviii, p. 141, pl. xxvi, figs. 7-10, a-c. Backstairs Passage, South Australia.

1921. *Phalium sinuosum* Gatliff and Gabriel, Proc. Roy. Soc. Vict., n.s., xxxiv, p. 143 (May 31, 1921).

Shell very small, regularly ovoid, spire elate, about half the length of the body whorl, aperture rather narrow, elongately reverse ear-shaped, sculpture of spiral lines only, with no external varix.

Coloration white, with about five spiral rows of square faint yellowish red spots.

Apical whorls, three, globose, smooth; adult whorls three, spirally closely grooved, the ridges a little broader than the interstices, ten lirae on first whorl, where obscure radials can be detected just below the suture, twelve lirae on second, radials even more obscure, whorl evenly rounded, no shoulder; on the body whorl just below suture half a dozen broader lirae with deeper grooves can be seen; radial growth lines with little sinuation crossing them. On the middle of the body whorl the lirae broaden and the grooves tend to disappear, but at the base the lirae become more crowded and stronger again.

Canal short recurved, a depression, scarcely an obscure gutter, preceding it into the false umbilicus, which is almost entirely closed by the columellar reflexion; an open umbilical aperture is noticeable.

Columella arcuate, finely wrinkled, the wrinkles continuing on the expansion, which is narrow and well marked anteriorly and continues as a

[38] Tate—Trans. Roy. Soc. S. Australia, xi, April, 1889, p. 166, pl. viii, fig. 2.

thin glaze across the body whorl to the posterior angle of the aperture, outer lip posteriorly receding and then sinuate anteriorly, bearing no varix but a little thickened internally (Verco wrote " faintly toothed ").

Dimensions.—Length 24 mm., breadth 15 mm. (type).

Distribution.—South Australia, Victoria.

Remarks.—This rare little species appears to be related to the fossil *C. sufflata* Tenison-Woods, judging from the columellar features. The sinuate outer lip is also seen in *A. semigranosum* Lamarck, though in the atter case an external varix is achieved.

FIXATION OF THE HABITAT, AND EXTENDED DESCRIPTION, OF *PTEROPUS TUBERCULATUS*, PETERS.

By

ELLIS LE G. TROUGHTON, Zoologist, Australian Museum.

(Figure 1.)

During July and August, 1926, Mr. A. A. Livingstone and myself were fortunate enough to visit Vanikoro Island, when, for five weeks spent collecting in the Santa Cruz Group on behalf of the Trustees of the Australian Museum, we had the pleasure of being the guests of Mr. N. S. Heffernan, then District Officer of the Group. Considerable interest attaches to Vanikoro as the scene of the loss of La Perouse's two ships the "Boussole" and "Astrolabe" in 1788, the fate of the intrepid navigator remaining a mystery for nearly forty years until Captain Peter Dillon discovered relics at Vanikoro in 1826.

Enhancing the interest of the fauna was the visitation in 1828 by a French expedition in a new "Astrolabe" commanded by Dumont D'Urville and having on board the famous naturalists Quoy and Gaimard, the first to make scientific observations and collections in this region. Their collections were naturally very incomplete and also subject to much confusion, so that it is very satisfactory to be able to clear up, after a lapse of nearly one hundred years, the mystery surrounding the habitat of the smaller of the two fruit-bats occurring at Vanikoro.

History of the two species.—In 1830 Quoy and Gaimard based their *Pteropus vanikorensis*, the large light-mantled fruit-bat of Vanikoro, upon two mounted skins and an odd skull said to have been obtained during the voyage of the "Astrolabe" and now in the Paris Museum. In 1912 Andersen, after examination of this material, retained the name *vanikorensis* for the species represented by the two skins, but decided that the odd skull (Paris Mus. Reg. No. 6746), erroneously described by Quoy and Gaimard and figured by Blainville as the skull of *vanikorensis*, represented a totally different species.

In 1869 Peters had described *Pteropus tuberculatus* based upon an adult female of unknown locality (Reg. No. A. 40) in the Paris Museum. Comparison of Blainville's figure of the odd skull from Vanikoro with Matschie's figure of the skull of Peter's type convinced Andersen of "the perfect identity of the characters of the skull and teeth." He refused, however, to regard the habitat of *tuberculatus* as established owing to the odd Vanikoro skull proving identical with that species, and arrived at the somewhat strained conclusion that "since Quoy and Gaimard were mistaken in referring the skull to *vanikorensis*, they may also have erred in stating that it was from Vanikoro," and that "So much only is sure, that Vanikoro and Guam are the only places visited by the 'Astrolabe' in which it can have been obtained."

On the contrary, in my opinion, it would have been more reasonable to assume that the odd skull had actually come from Vanikoro, since it was associated with skins also said to be from there, and that Quoy and Gaimard's ignorance of the existence of a second species, coupled with their failure to make a critical examination of the material, had led them to refer the odd skull of a second species to the much larger *vanikorensis*. The latter interpretation has proved correct, as we secured eight specimens at Vanikoro, three being collected by Mr. Heffernan, agreeing in all details with the description of *tuberculatus*, and enabling me to record the habitat of the species, unknown since its description, as Vanikoro in the Santa Cruz Group, and not the Marianne Islands, as Andersen suggested. Described by him as " this rare species " and hitherto known only by the unlocalised type and the odd skull, it is satisfactory to report the species as plentiful at Vanikoro, and to amplify the description and list of dimensions supplied by Andersen in his remarkable catalogue of Megachiroptera.

PTEROPUS TUBERCULATUS *Peters*.

(Fig. 1.)

Pteropus vanikorensis (part), Quoy & Gaimard, Voy. " Astrolabe" Zool. 1, 1830, p. 77 (skull, excl. skins and pl. ix), Vanikoro; *Id*., Temminck, Mon. Mamm., ii, 1837, p. 78 (pt. skull, not specimens), Vanikoro; *Id*., Blainville, Ostéogr. Mamm., Atl. Chéiropt., 1840 p. 100, pl. vi, fig. 3 (skull), Vanikoro.

Rousette de Vanicoro, Jourdan, Echo du Monde Sav.— iv, 1837, p. 156 (dentition compared with that of *Acerodon*).

Acerodon vanikorensis (part), Lesson, N. Tabl. R. Anim., Mamm., 1842, p. 14, No. 194, Vanikoro.

Pteropus tuberculatus, Peters, M.B. Akad. Berlin, 1869, p. 393 (habitat unknown); *Id*., Dobson, Cat. Chir. B.M., 1878, p. 58 (habitat unknown); *Id*., Trouessart, Cat. Mamm.. i, 1897, p. 82 (hab. unknown); *Id*., Matschie, Megachir., 1899, pl. viii, figs. 3, 3a-b (skull; hab. unknown); *Id*., Andersen, Cat. Chir. B.M., i, 1912, p. 309 (? Vanikoro or Marianne Is.).

Pteropus (*Spectrum*) *tuberculatus*, Matschie, Megachir., 1899, p. 29 (hab. unknown); *Id*., Trouessart, Cat. Mamm., Suppl., 1904, p. 54.

Diagnosis.—Similar in skull and dentition to *Pt. pselaphon* and *pilosus*, but with a small cusp-like projection on the hinder trenchant margin of the upper canine about the middle of the tooth. Fur shorter than in *pilosus*, mantle not paler but actually darker than the head and back. Size considerably smaller: forearm 119·5-124·5 mm. Hab. Vanikoro, Santa Cruz Group.

Dentition.—Examination of the teeth of my crania shows them to agree perfectly with Andersen's very complete description which is as follows:—

" Essentially as in *Pt. pselaphon* and *pilosus* but some of the chief characters of the dentition in these species (strong development of cingulum in upper incisors, upper and lower canines; enlargement of i_2 and p_1; tendency in longitudinal ridges of cheek-teeth to break up into tubercles) still more pronounced.—Upper incisors large; cingulum

excessively strong, forming a broad ledge on posterior face of teeth, in i^1 extending a little beyond external vertical margin of tooth, so as to be visible in front view of incisor as a small basal cusp on external side. Upper canines long, recurved, stout (as in *pilosus*); cingulum as in *pselaphon*, subdivided into a series of small tubercles; a small, well-marked cusp-like projection on posterior trenchant edge of canine above middle of tooth. Inner longitudinal ridge of m^1 and m_1 with pronounced tendency to break up into small, rounded, incompletely differentiated tubercles.—i_2 very large, between four and five times the bulk of i_1. p_1 unusually large, larger than i_2, and more than twice the size of m_2.—Other characters as in *pselaphon* and *pilosus*."

The measurements of individual teeth are also in accord with those tabulated by Andersen.

Fur.—As in *pilosus*, but rather shorter; approximate length of hairs, back 16, mantle 16 mm.; hairs of back about 14 mm. in female. Glandular tuft of hairs present on each side of the neck in the male. Wing membrane below sparsely haired along the proximal half of the forearm and outwards to a line between the elbow and knee. Upper side of tibia furred for proximal half or two thirds.

Colour:—According to Andersen "The type and only skin known (Paris Museum) is probably faded by exposure to light. In its present condition the whole pelage above and beneath is some shade of russet-brown, darkest (almost vandyck-brown) on mantle, sides of neck, fore-neck and face; palest (russet washed with a peculiar tinge of ochraceous) on back, breast, belly, and flanks."

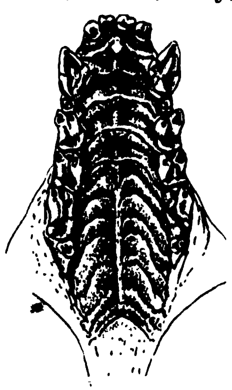


Fig. 1·
Pteropus tuberculatus Peters.
Note cusp-like notch on hind margin of canines.

In a fresh skin of an adult male I find the colour as follows:—Crown of head brownish tawny-olive. Cheeks grizzled blackish-brown. Back tawny sepia tinged with russet, the general colour somewhat darker than that of the crown of the head. Mantle darker than crown or back, of a dark mummy brown, tinged with vandyke which is strongest in front of the shoulders; the colour of the mantle is continued around the sides to the undersurface of the neck, where there are two ochraceous-tawny glandular tufts in the male. Breast and belly sepia, grizzled with shining buffy and russet hairs. Sides of belly and undersurface of arms dark wood brown. Hairs on undersurface of wing membranes light auburn. The fresh skin of an adult female does not show marked variation from the male, though the general colouration is richer above and below; the ochraceous tawny wash of the back is warmer and especially marked in a band edging the mantle behind. The under surface is decidedly darker in tone, the vandyke shade being more pronounced.

Palate-ridges.—No special modifications (Fig. 1). Formula $5 + 5 + 3$, though there is an indication in one male of an additional ridge between the normal ninth and tenth ridges, approaching the formula $5 + 6 + 3$; the additional ridge is not indicated in a female.

External Measurements of *Pteropus tuberculatus*.

	Peter's Type. Ad. fmle. Paris M.	3 ad. females Austr. Mus. M.3851-3.		5 ad. males Austr. Mus. M.3846-3850.	
		Min.	Max.	Min.	Max.
	mm.	mm.	mm.	mm.	mm.
Forearm	119·5	119·5	125	112	124·5
Pollex, total length, c.u. ...	50	47·5	51	51	51·8
,, metacarpal	12·5	11·2	12	12	12
,, 1st phalanx	25	22·5	25	23·5	24·3
2nd digit, metacarpal	59·5	57·5	60	56	61
,, 1st phalanx	14	14	15	14	14·5
,, 2nd-3rd phalanx, c.u.	13·5	12·5	12	13·8	15
3rd digit, metacarpal	83	76·8	84	78	82·8
,, 1st phalanx	65	60·5	64	61	63
,, 2nd phalanx	...	88·5	93	85	88·5
4th digit, metacarpal	80·5	76	81	77	82·5
,, 1st phalanx	53·5	49	53	50·5	52·5
,, 2nd phalanx	56·5	51·3	55	52·3	53·5
5th digit, metacarpal	88	84	90·2	83·3	90·5
,, 1st phalanx	38·5	35·5	37·5	37	37
,, 2nd phalanx	42	39·8	41	38·5	39·5
Ear, length from orifice ...	...	20	18·5	18·5	20·2
,, max. width, flattened ...	...	13	13	12·5	13·2
Front of eye to tip of muzzle ...	...	20·5	22·3	22·2	23
Lower leg	49	49·5	52	51·5	51·5
Foot, c.u.	...	35	38	35·5	37·5
Calcar	...	12	13	11·5	14·3

Cranial Measurements of *Pteropus tuberculatus*.

	Adult Paris Mus. 6746.	Ad. male. Aust. Mus. M.3850	Ad. female. Aust. Mus. M.3852
	mm.	mm.	mm.
Total length to gnathion	56·8	55·5	54·3
Palation to incisive foramina	25·7	26·7	25·7
Front of orbit to tip of nasals... ...	15·5	16·7	15·6
Width of brain-case at zygomata ...	22·8	21·7	22·5
Zygomatic width	33	33	33·8
Width across m^1, externally ...	15·8	15·9	15·8
Lachrymal width	13	13	13
Width across canines, externally ...	13·8	13·6	13·7
Postorbital constriction	7·7	6·5	7·7
Interorbital constriction	8·5	8·4	8·4
Width of mesopterygoid fossa ...	7·2	7	7
Between p^4-p^4, internally ...	8·8	8·8	9
Between cingula of canines	7	7	7·2
Orbital diameter	11·7	11·5	11·5
Mandible, length	43·2	43	42·5
,, coronoid height	25	23·9	25·5
Upper teeth, c-m^2	21·5	21·3	20
Lower teeth, c-m_3	23·8	23·7	23
Upper incisors, combined width ...	7	7	6·9

Specimens examined.—A series of eight specimens comprising five males and three females, all adult.

Range.—Vanikoro Island, Santa Cruz Group.

Type.—In the Paris Museum.

General affinities.—The species belongs to the *Pt. pselaphon* group of Micronesian range, which is closely related to the south Polynesian *Pt. samoënsis* group, the characters of the skull being nearly identical, and thedentition similar in many important points. The unusually broad posterior basal ledges of the upper incisors in the *Pt. pselaphon* group serve to distinguish its members from those of the latter group, in which the posterior ledges of the upper incisors are of normal breadth. Both in cranial and dental characters the *pselaphon* group shows a decided tendency towards the highly specialised genus *Pteralopex* of the Solomon Islands.

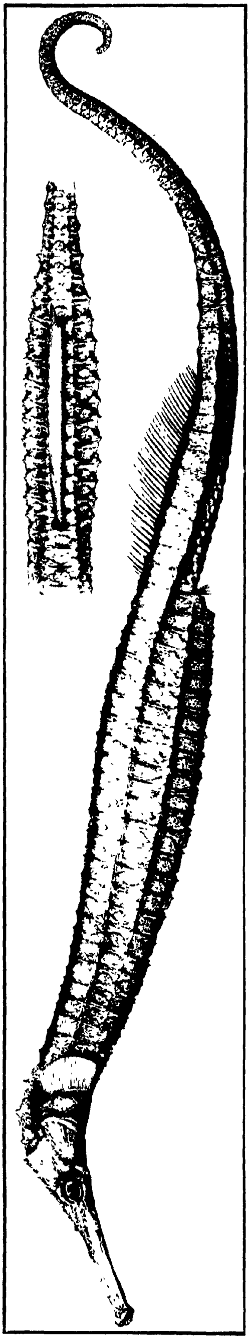
Specific affinities.—Peters considered this species allied to *Pt. mackloti*, but Matschie pointed out, and Andersen concurred, that that view had no foundation whatever; the closest relatives amongst known species are *pselaphon* (Bonin and Volcano Islands) and *pilosus* (Pelew Islands), from which it differs only in characters of minor importance—details of dentition, length and colour of fur, and size. The two most important distinguishing features are the presence of the small secondary cusp on the hinder margin of the upper canines, and the shorter forearm (119·5-124·5), as opposed to 132-151 mm. of the allied species.

The definite recording of the locality of *tuberculatus* clears up an uncertainty of long standing, and should facilitate further study of the affinities of other insular groups and their species.

EXPLANATION OF PLATE XXIV.

Fig. 1. *Solegnathus dunckeri* Whitley, sp. nov. Holotype, 463 mm. long, from Lord Howe Island. Above, dorsal aspect of expanded medio-lateral ridges.

„ 2. *Megalaspis cordyla* (Linnaeus). A specimen, 186 mm. from snout to end of middle caudal rays, from La Perouse, New South Wales.



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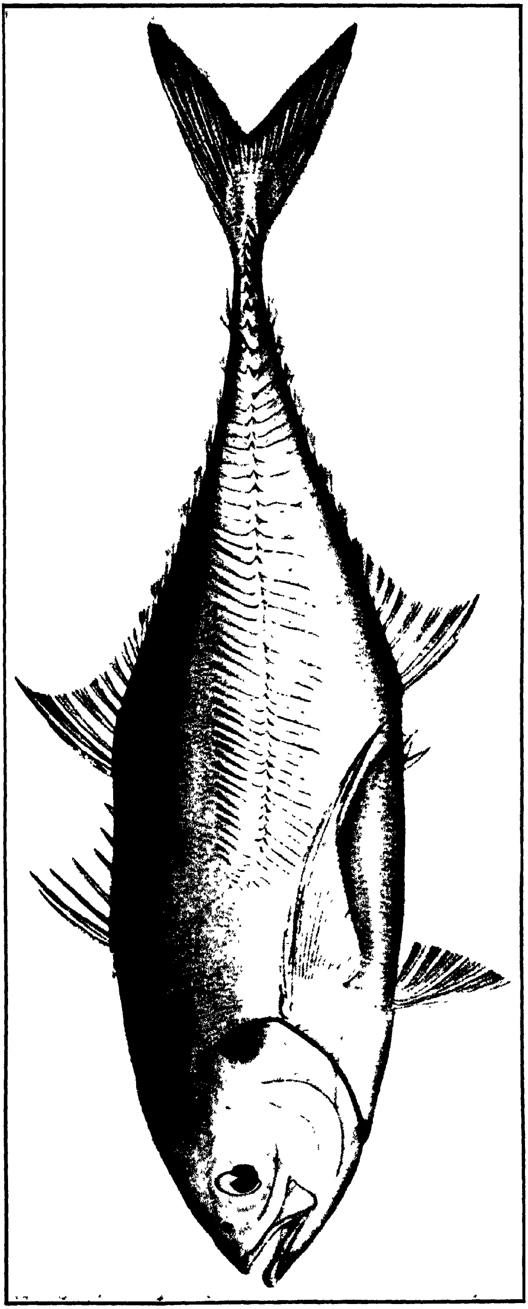
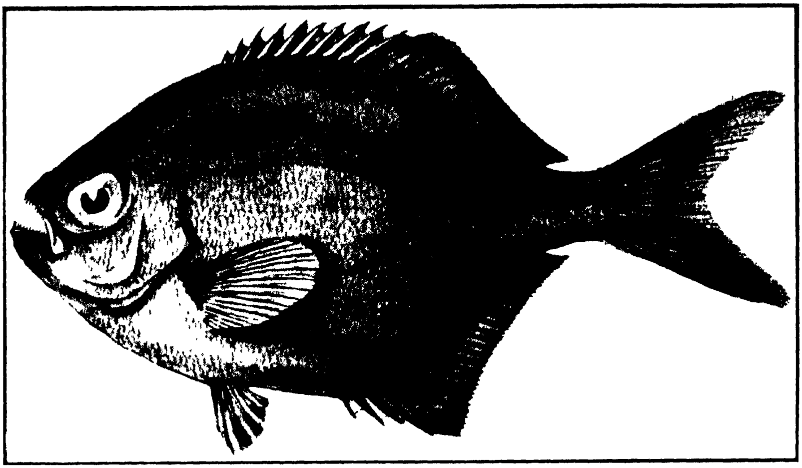


G. P. WHITLEY, del.

EXPLANATION OF PLATE XXV.

Fig. 1. *Scorpis lineolatus* Kner. A young specimen, 102 mm. long from snout to end of middle caudal rays, from Coogee, New South Wales.

„ 2. *Trachipterus jacksonensis* (Ramsay). A specimen, about 1925 mm. long, from Middle Harbour, Port Jackson, New South Wales.



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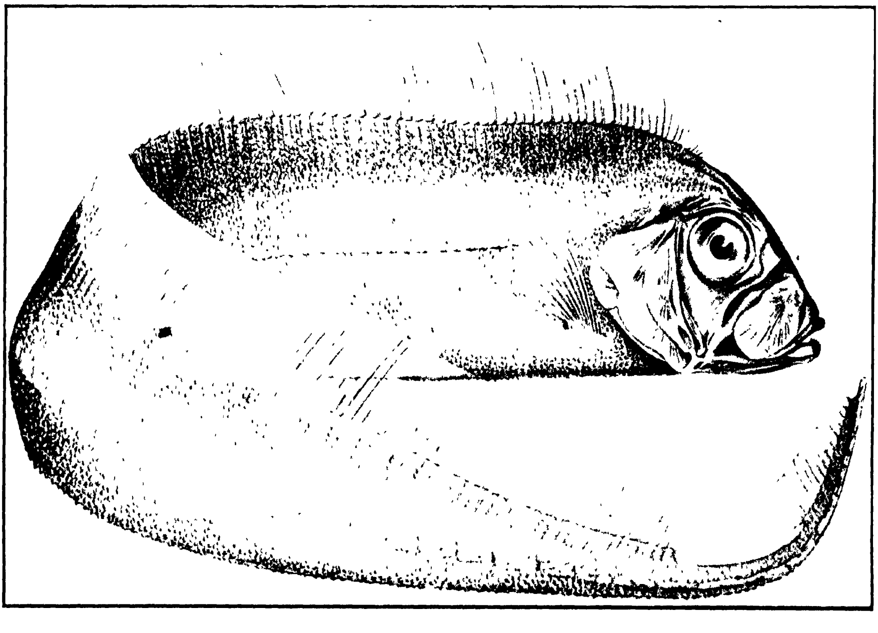

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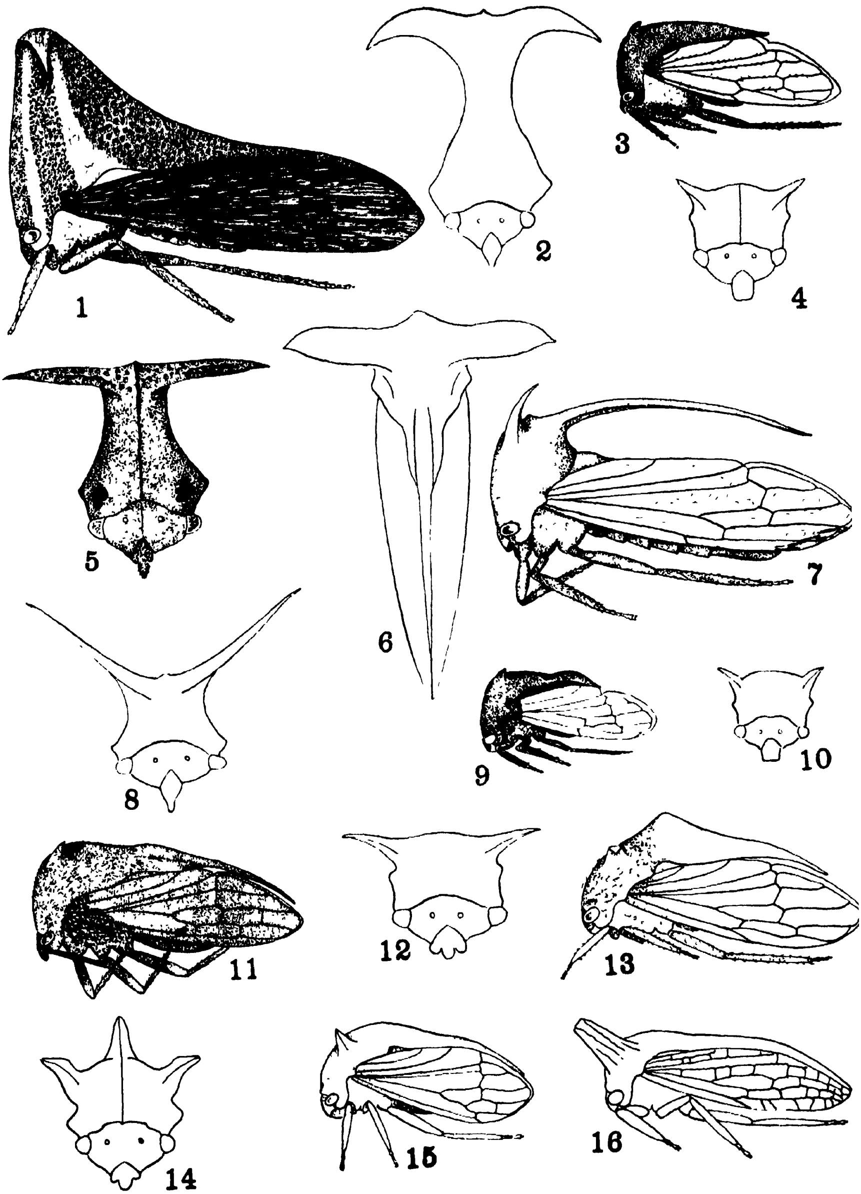
G. P. WHITLEY, (1), del.
A. R. MCCULLOCH, (2), del.

EXPLANATION OF PLATE XXVI.

Fig.	1.	*Emphusis bicornis*, sp. nov.	Lateral view.
,,	2.	,, ,, ,,	Cephalic outline.
,,	3.	*Centrotypus nigris*, sp. nov.	Lateral view.
,,	4.	,, ,, ,	Cephalic outline.
,,	5.	*Eufairmairia laticornis*, sp. nov.	Cephalic view.
,,	6.	,, ,, ,,	Dorsal outline.
,,	7.	*Leptocentrus gracilis*, sp. nov.	Lateral view.
,,	8.	,, ,, ,,	Cephalic outline.
,,	9.	*Tricentrus pinguidorsis*, sp. nov.	Lateral view.
,,	10.	,, ,, ,,	Cephalic outline.
,,	11.	*Otinotoides brunneus*, sp. nov.	Lateral view.
,,	12.	,, ,, ,,	Cephalic outline.
,,	13.	*Acanthucus pyramidatus*, sp. nov.	Lateral view.
,,	14.	,, ,, ,,	Cephalic outline.
,,	15.	*Acanthucus carinatus*, sp. nov.	Lateral view.
,,	16.	*Sextius projectus*, sp. nov.	Lateral outline.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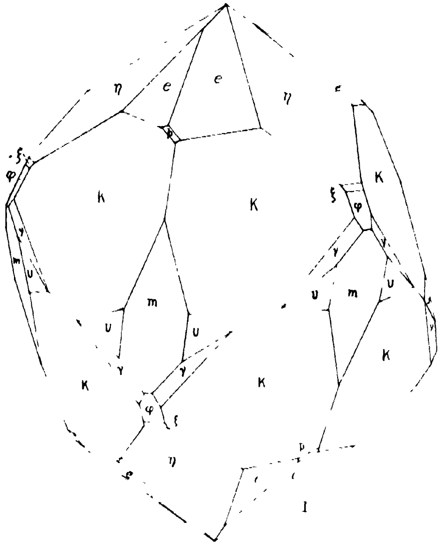
EXPLANATION OF PLATE XXVII.

Figs. 1-4. Calcite, Garibaldi Mine, Lionsville, New South Wales.
Forms : $o(0001)$, $b(11\bar{2}0)$, $\gamma(80\bar{8}1)$, $\eta\cdot(\bar{4}\bar{4}85)$, $p\cdot(11\bar{2}1)$, $\xi\cdot(\bar{4}\bar{4}83)$, $\varphi\cdot(\bar{2}\bar{2}41)$, $m\cdot(44\bar{8}\bar{1})$, $H\cdot(\bar{8}\ \bar{8}\ 16\ 1)$, $e{:}(21\bar{3}2)$, $K{:}(41\bar{5}1)$, ¥ $\vdots(\bar{8}\ \bar{4}\ 12\ 1)$, $U(62\bar{8}1)$.

Fig. 5. Calcite, Hanging Rock, Nundle, New South Wales.
Forms : $b(11\bar{2}\bar{0})$, $f\cdot(11\bar{2}2)$.



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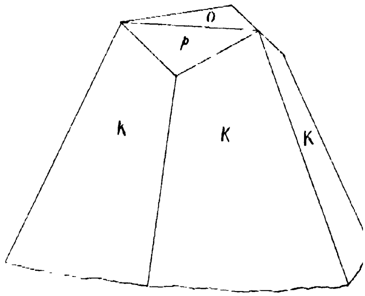

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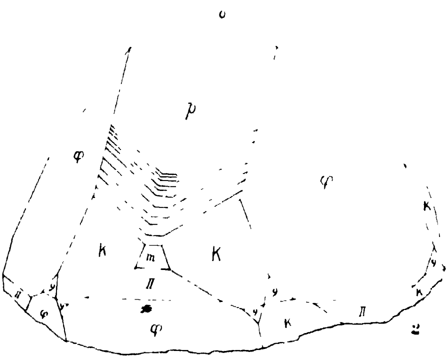

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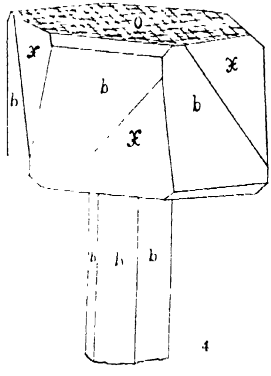

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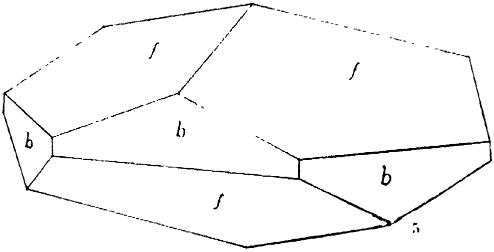

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T. HODGE SMITH, del.

EXPLANATION OF PLATE XXVIII.

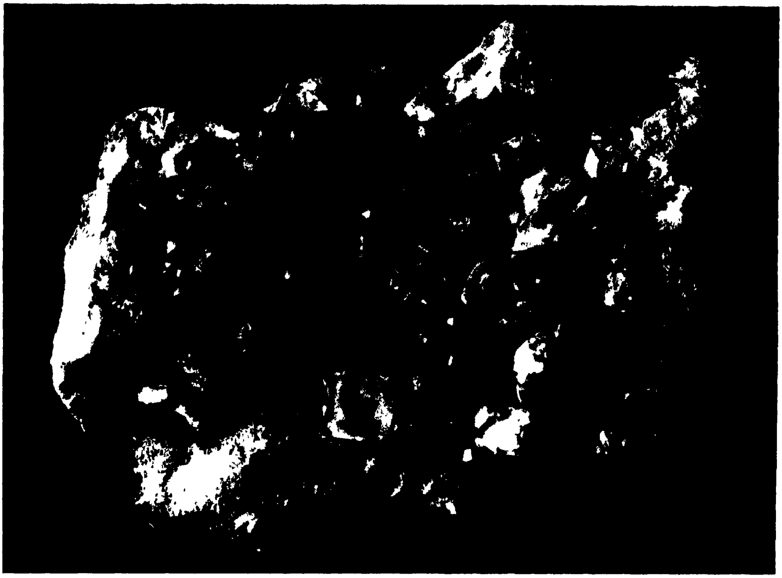
Calcite, Lionsville, New South Wales, showing crystals of the rhombohedral-scalenohedron (type II) and prismatic habit.

G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXIX.

Fig. 1. Calcite, Garibaldi Mine, Lionsville, New South Wales. A typical group of the small rhombohedral-scalenohedral (type I) crystals.

„ 2. Calcite, Hanging Rock, Nundle, New South Wales. Note the prism faces coated with minute crystals of pyrite.



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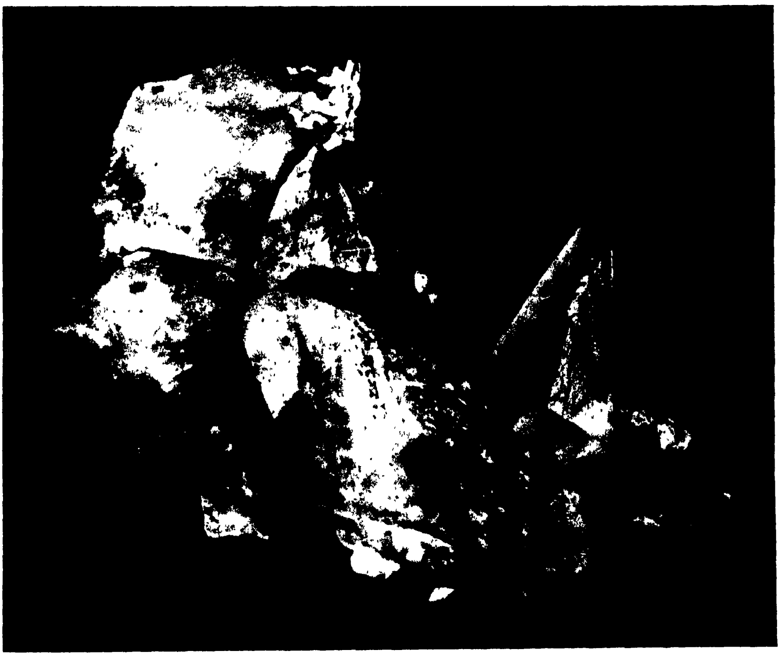

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G. C. CLUTTON, photo.

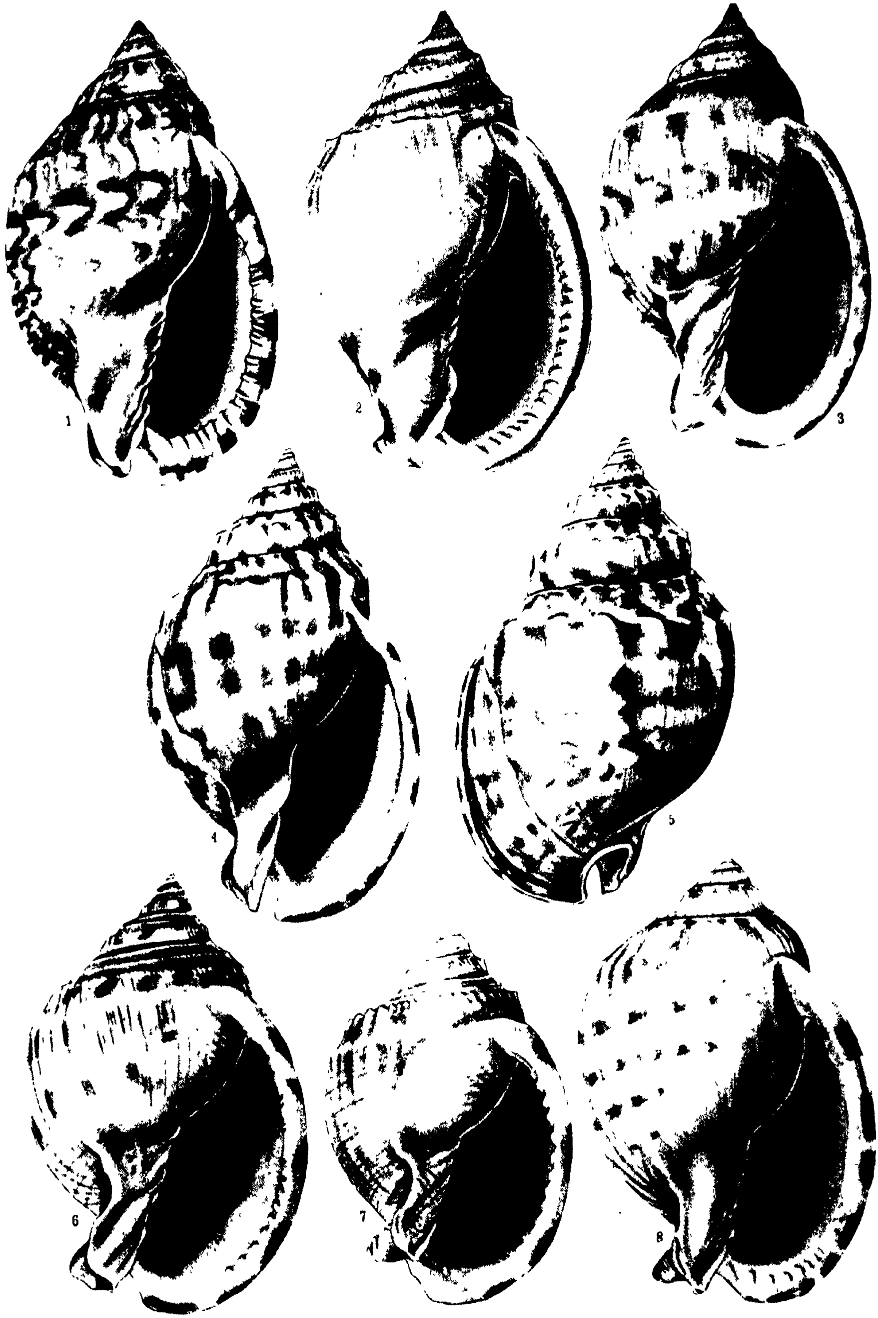
EXPLANATION OF PLATE XXX.

A view of the calcite dump at the entrance of the Garibaldi Mine, Lionsville, New South Wales. This material has been rejected as unsuitable for optical purposes and conveys some idea of the size of individual crystals.

C. M. G. FRIEND, photo.

EXPLANATION OF PLATE XXXI.

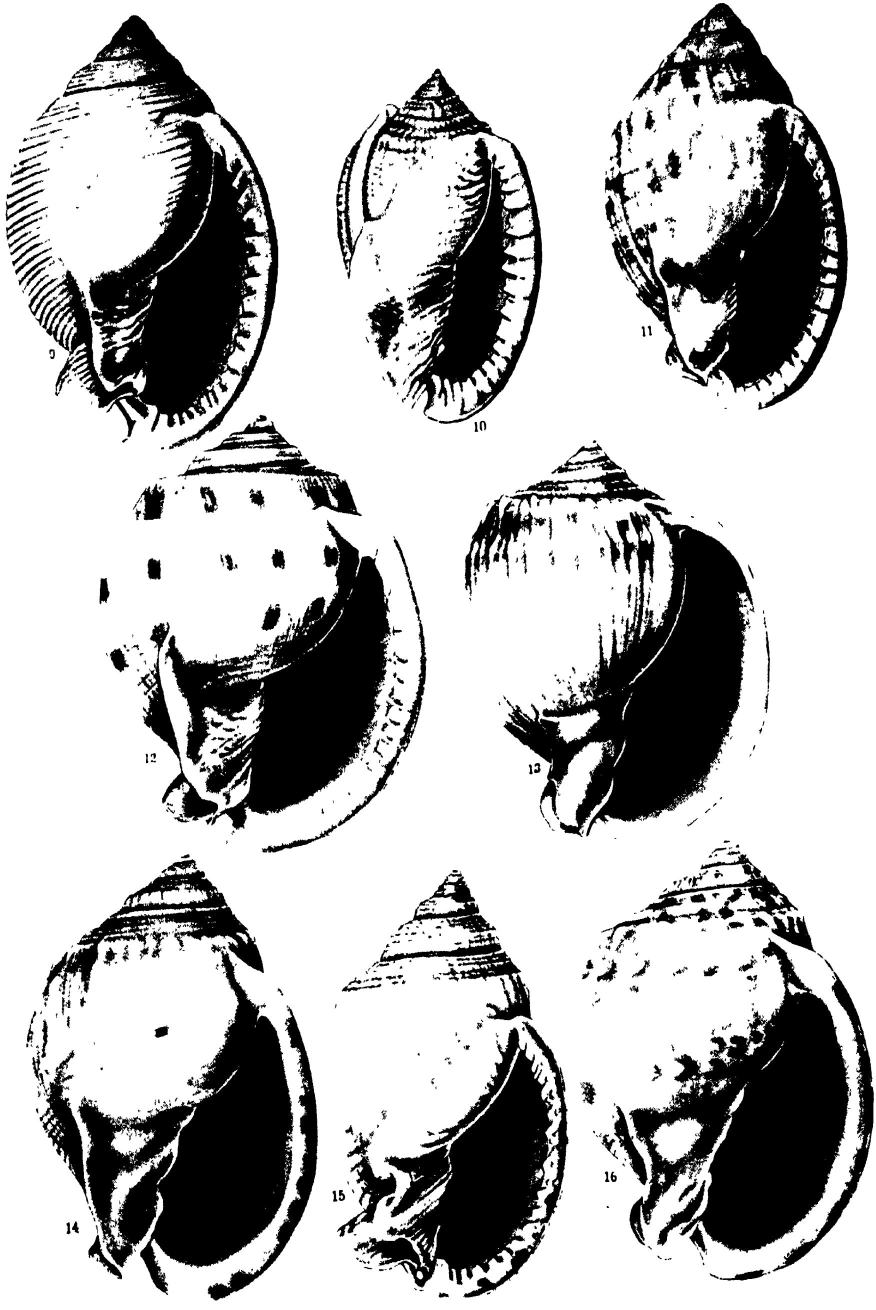
Fig. 1. *Xenogalea labiata* (Perry).
" 2. *paucirugis* (Menke).
" 3. *stadialis* (Hedley).
" 4, 5. *Xenophalium hedleyi* Iredale, front and back views of type.
" 6, 7. *Xenogalea thomsoni* (Brazier), normal form and type.
" 8. *Xenogalea insperata* Iredale, type.



JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XXXII.

Fig. 9. *Semicassis diuturna* Iredale, type.
,, 10. *Phalium agnitum* Iredale, type.
,, 11. *Xenogalea lucrativa* Iredale, type.
,, 12. *sophia* (Brazier), type.
,, 13. *nivea* (Brazier), type.
,, 14, 16 *pyrum* (Lamarck), typical specimen and normal Tasmanian shell.
,, 15. *angasi* Iredale, type.



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